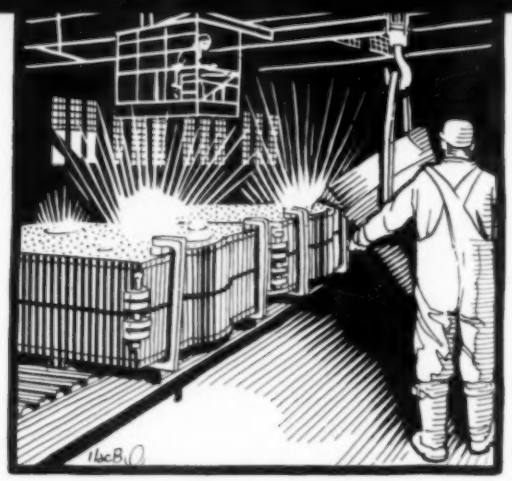


THE FOUNDRY

for October

Sellers Need

A Breathing Spell

WE ALL like to be shrewd buyers. We seek values at a low price. Bargain hunting is universal. We can't indict the entire human race for a trait all possess.

But the cut-price buyer is a chiseler. This is a fighting term. It was used to whip up bigotry that hung the NRA noose on business. It is the rallying cry for further attempts at regimentation in the next congress.

Just where is the line that separates shrewd buying from chiseling? Comparisons in different localities may uncover the manufacturer who chisels labor. He is out in the open and exposed. The buyer who *forces* prices below costs is more dangerous. He is a wrecker. Why does business tolerate such buyers? Why should not all business condemn destructive buying? Why not expose chiselers who buy below cost?

Big business should see the danger to large sales of their own products. If large companies bought commodities only from those who can sell at a profit, the present tide of activity would be swelled into a flood. Buying on an honest basis which gave the suppliers a profit would help all business. It would produce results that would shame all PWA, WPA schemes for pump priming.

An automotive firm buying its materials on a basis of profit to the seller creates buyers for automobiles. Employes of a foundry selling castings at a profit are next year's prospects for automobiles, washers and refrigerators. Foundries making a profit buy machines, equipment, materials, brick and employ more men.

Why not adopt the fair deal in business?

The profit motive upholds the only sound social system. Why buy goods made and sold at a loss? Why permit destructive buying in your firm? Why sell your products at prices which means lower wages to your employes, loss to your stockholders, your suppliers, your industry?

Castings on Parade

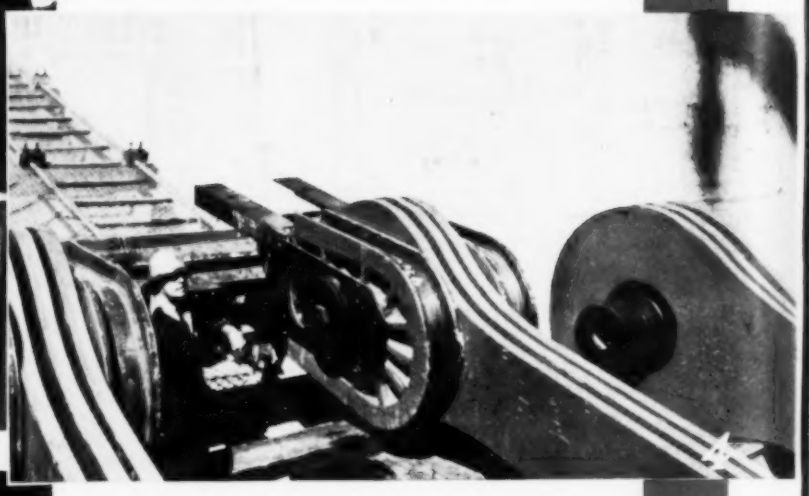
THE FOUNDRY commends those foundrymen who exhibited castings at recent industrial shows. Vision, initiative, confidence build business. Direct sales and many prospects rewarded those who ably displayed their products at the Machine Tool show. Detailed reports are not available from the thirteen foundries displaying gray iron, steel and nonferrous, sand and die castings at the National Metal Exposition closing in Chicago Oct. 4. But it is safe to guess they profited. In addition many suppliers of materials, alloys and equipment featured cast products before a large and miscellaneous attendance. Such direct merchandising is valuable. It helps those that participate. It helps the foundry industry.

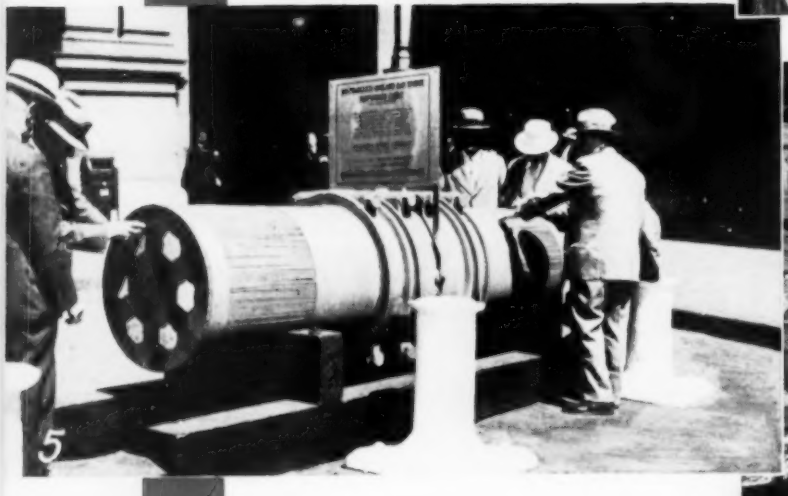
When Reciprocity Isn't

SEVERAL of America's largest firms have placed increasing stress on reciprocity. Some even maintain special executives, vice presidents in charge of reciprocity who pass upon all sizeable tenders. Those who sell motors to such firms, must submit to scrutiny as to the dollar volume of the buyer's product that the motor makers take. Then pressure is brought to drive prices down. This practice has been carried to extremes in the lean days since 1929. Railroads practice reciprocity even in small purchases, weighing freight business received in the balance with oil, castings, and other sundry requirements.

The principle of reciprocity is not wrong, but its application may lead to abuse. Often, it is an additional lever to overturn fair prices. True reciprocity gives each party a chance to make a profit.

Editor





MANY CASTINGS ARE USED

EVER since the first aborigine, either in the role of the hunter or the hunted, discovered that a fallen tree presented a safe and easy passage over a gash in the earth or a body of water too wide to be jumped, mankind has been interested in the development and construction of bridges of one kind or another. Without taking into consideration a myriad of interlocking factors, it is fairly safe to say that the progress and civilization of the human race parallels closely the evolution of the bridge.

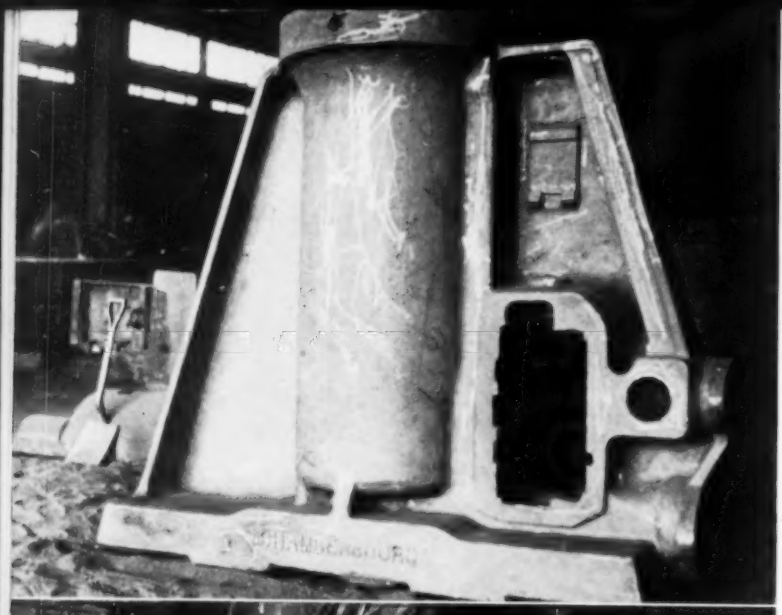
Figs. 1 and 2—North cable saddle being swung into position. Fig. 3—Saddle in position. Fig. 4—Strand shoes at anchorage. Fig. 5—Model section of cable. Fig. 6—Rocker post shoes for center anchorage

On San Francisco Bridge

Among remote and primitive people in sparsely settled areas, the fallen tree still does duty over comparatively narrow streams. Twisted vines or fiber ropes moored at the ends and supporting narrow cat walks offer a swaying and precarious passage over wider streams or chasms.

The first may be regarded as the prototype of both the beam and arch type of modern bridges, while the second easily may be recognized as the third main modern type, the suspension bridge. *(Please turn to page 56)*

Fig. 7—Bearing pin, 27 inches in diameter. Fig. 8—South cable saddle. Fig. 9—Cable splay castings. Fig. 10—South cable saddle in position. Fig. 11. North cable saddle. Fig. 12—Two cable saddles



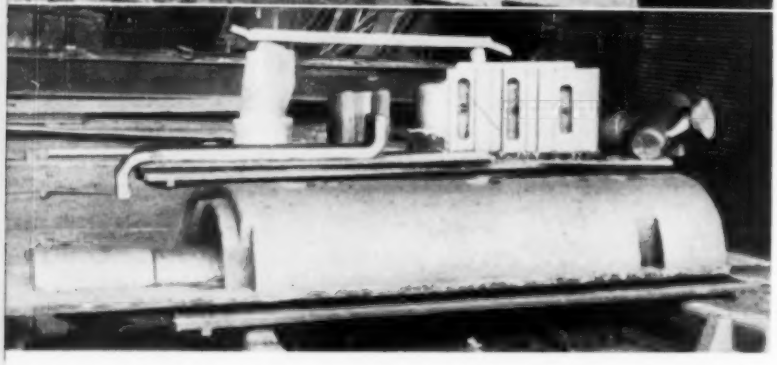


Fig. 1 (Above)—Cylinder and base for steam hammer. Fig. 2 (Below)—Set of cores for casting shown in Fig. 1

Increases Strength With Alloys

By PAT DWYER

IN THE morning of July 30, 1864 a troop of fierce eyed, bearded and hard riding cavalrymen dressed in Confederate gray poured like a torrent into Chambersburg, Pa., where the leader, Gen. McCausland made a flat demand for $100,000 in gold. Under existing conditions, after nearly 4 years of exhausting civil warfare, he might just as well have asked for a hundred million and stood as good a chance of collecting that sum. The horrified town fathers protested that the demand was preposterous, outrageous and impossible of fulfilment.

"Put up or shut up" the general snapped. He was a man of few words, as behooved a leader, the advance spear head of Jubal Early's division moving hurriedly in hostile territory where he might be cut off and annihilated at any moment. "Plank down the coin." He jerked his thumb in the direction of his fire eaters "Plank down the coin, or I burn the town!" Loud cheers from the men on horseback. War is war. The essence of war is destruction. What are we hanging here for? Burn 'er up and let's go..

They burned 'er up. They burned 'er down. They burned 'er from end to end and from side to side. They set the torch to private dwellings, stores, factories, banks and public buildings and then with jingling bridle chains, creaking leather, wild shouts and sabers flourished aloft they raced out of the town as they had entered in a swirl of smoke and dust. Where they had found a thrifty, bustling progressive community, they left a heap of smoldering ashes representing a property loss of $1,000,000. War is an expensive luxury, ironically enough paid for by those who get nothing out of it.

Second Foundry Superior to Oid

Among the plants destroyed on this historic occasion was that of the Chambersburg Engineering Co., which had been established several years before. The plant, the tools, the equipment and all tangible assets were destroyed, but the personnel remained. The man who built the first plant cleared away the ashes and built a second plant in many respects superior to the old one. In the succeeding years the plant has been enlarged and improved to meet changing conditions which necessitated occasional switches from one manufacturing line to another. In recent years the company has concentrated most of its activities in the production of steam and board hammers, anvils and related forging equipment in an almost infinite range of sizes and types.

Development of a special alloy iron for these castings led to its introduction also into castings for dies, beds for heavy duty machine tools, steam cylinders, liners and rings, large hydraulically operated gates and valves, crushing machinery, rabbling equipment, feed hoppers, and vessels for the chemical industry where impermeability of the metal is of vital importance.

Alloy irons had been gaining in popularity in recent years, particularly in small and medium size castings. However, practically no data were available on castings as large as those used in hammers and as a result the Chambersburg foundry engineering staff blazed its own trail in the development of a special metal. As with many other developments, the present proprietary metal resulted from the metallurgical research undertaken during the depression with a view of increasing the production capacity and accuracy, and reduce the maintenance cost of the forging hammer. The aim was a metal for anvils and frames combining the mass and vibration resisting properties of gray iron with the strength and wear resisting properties of steel.

The chief characteristics of the new metal are a fine homogeneous grain structure, tensile strength of from 40,000 to 50,000 pounds per square inch and a brinell hardness which can be

controlled in the furnace to suit the purpose for which the casting is intended. Carbon content can be controlled within 0.05 per cent, plus or minus. As a result of a fine graphite free grain structure the metal may be machined to a clean, smooth surface.

Metal is melted in a battery of three oil fired air furnaces, designed and built by the company. The oil is preheated and the flame enters the furnace at one end. The furnaces, one of which is shown in Fig. 3, are located outside the foundry for convenience in charging with a crane through the removable bung top. This applies particularly to large pieces of scrap, anvils, frames and similar miscellaneous scrap which are not acceptable to the majority of foundrymen. Each furnace has a capacity of 40,000 to 50,000 pounds, or sufficient if necessary to pour a 75-ton casting. Up to the present the heaviest casting made in the foundry was an anvil block weighing 105,000 pounds cleaned. The furnace charge was 126,000 pounds to take care of the gates and sink heads.

Several Alloys Used in Iron

Many of the anvil blocks and other castings purchased as scrap are too large for the furnace. Also they are too massive to be broken in the ordinary manner under a drop ball. These pieces are taken to the machine shop and placed either in a lathe or on a large planer and given one or more deep cuts. They then are broken apart by driving wedges in the cuts. The usual furnace charge is made up of 70 per cent scrap, and 30 per cent malleable pig iron with low sulphur and phosphorus content and carbon under 3.00 per cent. Alloy additions to the charge include molybdenum 0.30 to 0.50 per cent, chromium 0.35 per cent and nickel 0.60 to 1.50 per cent. The nickel is omitted from the charges for the anvil castings. Maximum tensile strength of this iron is 55,000 pounds per square inch.

In cooling, the metal shrinks to a considerably greater extent than ordinary gray iron and for that reason it is necessary to provide large risers or sink heads on all castings. The usual

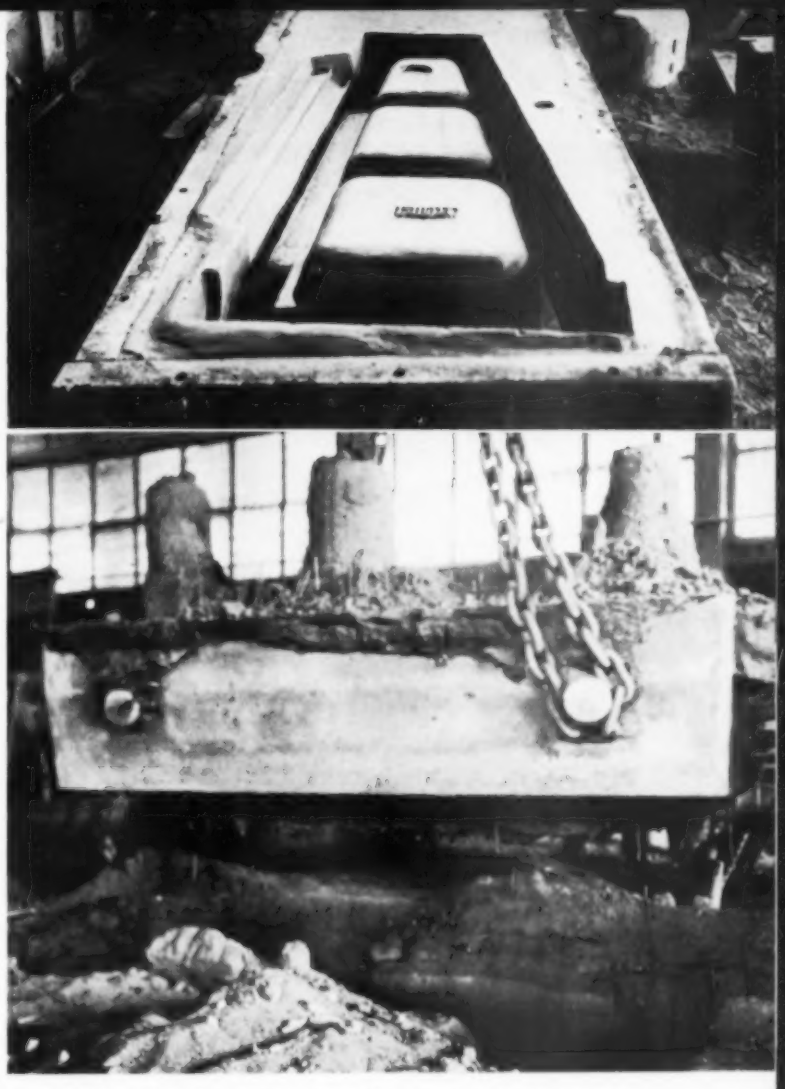
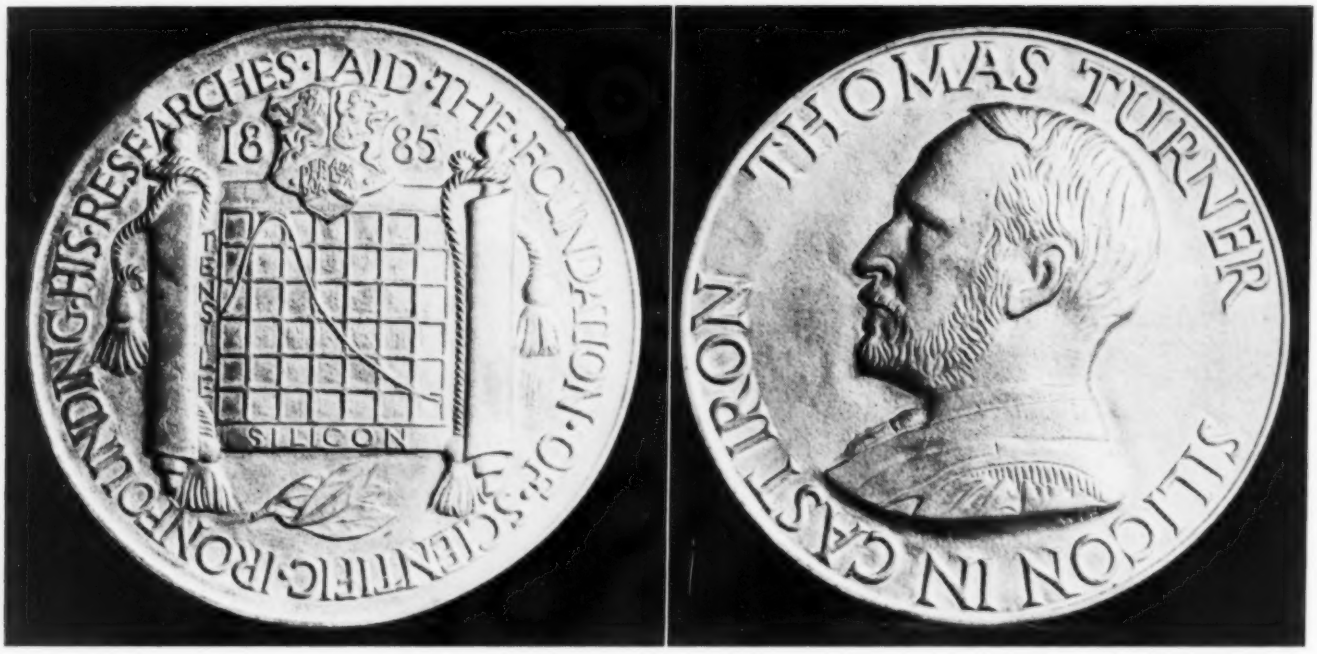


Fig. 4 (Above)—The sprue located about midway at one side extends to a gate at the bottom of the mold. Fig. 5 (Below)—Anvil bases are gated at both ends near the bottom and fed by several large risers

method in pouring the castings is to cease pouring metal through the gate when the metal appears in the bottom of the sink head. Fresh, hot metal then is poured into the sink heads until they are filled to the top. The anvil casting shown in Fig. 5 is provided with two 15-inch diameter and one 21-inch diameter risers, all 3 feet high.

Castings of that kind are molded in the floor, the larger sizes in concrete lined pits. Sand is excavated to the required depth and a layer of coke approximately 6 inches is spread over the bottom. Pieces of steel pipe are erected at each corner to serve as vents. A course of floor sand is rammed over the coke, followed by a 2-inch thickness of facing sand. The face is vented with a wire and then the surface is scraped off flat with a straight edge riding on two parallel straight edges bedded in the sand on either side. A longitudinal ridge is built up in (*Please turn to page* 60)

Fig. 3—Roof bungs are removed for placing the charge in oil fired air furnace



Gray iron reproduction of a gold medal struck in 1925 in commemoration of the first studies of the effect of silicon on cast iron

Mark Half Century Anniversary

Studies by Prof. Turner on silicon in cast iron first published fifty years ago

By VINCENT DELPORT
European Manager, The Foundry

JUST 50 years ago in the *Journal* of The Chemical society of Great Britain, Thomas Turner published his paper "The Influence of Silicon on the Properties of Cast Iron." That publication, noteworthy in its time, was destined to become the foundation and basis upon which was erected the modern metallurgy of gray cast iron.

The far reaching influence of that paper and the preceding studies and tests were foreseen by Professor Turner, then a demonstrator of chemistry at Mason college and were noted in his introductory paragraph. He said:

"In order to render our knowledge of the chemistry of iron complete, and at the same time of practical use for everyday application, it is necessary that we should possess accurate information on two points. First, a ready and correct method for the estimation of the amount of each constituent, and secondly, a knowledge of the exact influence on the character of the product, which is exerted by different quantities of each element present."

Professor Turner's original research on the influence of silicon, in later years became more and more accepted as fundamental and was the basis of much research which followed. At the time he published his paper he was 24 years of age. Mason college which had opened in 1881 later became the first of the provincial universities, the University of Birmingham.

At the time, following the Crimean war, a number of cast-irons had been analyzed and tested at Woolwich arsenal. Professor Turner segregated these irons in relation to their silicon content and studied the effects of the various compositions.

The results of his researches, as given in his original paper, were confirmed by Charles Wood in England, by Gautier in France, and by W. J. Keep, of Detroit, in U. S. A.

At the time he was conducting his experiments he only possessed a small coke-fired pot furnace capable of melting (*Please turn to page* 62)

Foundry Equipment Purchases Increase

FOR approximately 6 years the durable goods industries of this country have been struggling to change the situation in which they found themselves. Numerous investigations and reports have shown that the drag on recovery rested with the durable goods industries. Consumers groups have recovered more rapidly than have those industries which are dependent upon capital expenditures.

The decline in purchases of capital goods during the past 6 years has created a back-up demand for a large volume of machinery and equipment. One group, representing a number of branches of manufacture, estimates that the depression years developed a demand for machinery in excess of eighteen billion dollars.

That the foundry equipment field is increasingly active is indicated by Arthur J. Tuscany, Cleveland, executive secretary of the Foundry Equipment Manufacturers' association, who estimates a present market for foundry equipment at more than $25,000,000. The figure only includes items, the purchase of which has been delayed due to desire to reduce capital expenditures. It does not take into account the replacement of equipment which has deteriorated from non-use, nor the large volume of equipment which will be found necessary because of the extreme shortage of available skilled help.

The fortunes of all branches of the foundry industry are intimately related to the durable goods field. While it is true, due to the extremely broad field which is served by castings, that this industry feels increase or decrease in practically all lines of manufacture, it is recognized that higher activity in the durable goods industries will increase casting tonnages.

The machine tool show gave evidence of increased activity in durable goods. The index of machine tool orders, published by the National Machine Tool Builders association, Cleveland, has shown an upward trend for many months. The recent low point in this industry was in early 1933, when the index stood at 10 per cent of average monthly shipments for the year 1926, which base is used as 100 per cent in this compilation. The remaining months of 1933 showed increases, with a slight recession taking place in the earlier months of 1934, which recession was halted in mid-year, when the figures showed an increase. This continued increase indicates that the industry passed its 15-year moving average of activity in May of 1935. June, July and August showed continued unusual increases, the figure for August as a matter of fact reaching almost 130 per cent or nearly 30 per cent above the average monthly shipments for the year 1926. The reports from exhibitors at the machine tool show confirm the belief that an unusual buying movement is under way.

The monthly index of foundry equipment orders compiled by the Foundry Equipment Manufacturers' association shows a similar quickening advance. This organization uses the average monthly orders for (*Please turn to Page* 64)

Studies Green and Dry Strengths

Strength contact area largely rearranged between each drying, retempering and use

By H. N. ROSE
Industrial Minerals Co., Lancaster, O.

OVER a period of two years, a number of generally used naturally bonded molding sands have been tested, using the standard A.F.A. methods. In all, 69 individual tests were made. All tests were at controlled moistures of 6, 8 and 10 per cent plus or minus 0.1 per cent and comprised unmulled green tensile, compression, shear, dry tensile and compression strengths. Identical tests of duplicate samples, each mulled four minutes also were made. The sands varied in clay content from 7.8 to 32.3 per cent and the fineness from 46 to 238. Pan material varied from 1.4 to 43.6 per cent.

It was thought by making identical tests of so many sands, unmulled and mulled, at various controlled moistures, that the effect of moisture in the development of their green and dry strengths might be revealed more clearly.

It is unnecessary for the purpose of this discussion to set forth the details of the test results —30 separate strength determinations for each of the 69 sands tested. The average green tensile and compression with the average dry tensile and compression values, all at the different moistures, both unmulled and mulled, are reported as though for one sand. It should be explained that reference is made to these average values as though speaking of one sand and in other parts of the paper reference is made to values developed by indvidual tests.

Notwithstanding the widely different clay contents and other physical characteristics of these sands, it was found that all reacted alike in the following particulars:

MULLED TESTS: Highest green strength and lowest dry strength were developed at 6 per cent moisture. Lowest green strength and highest dry strength were developed at 10 per cent moisture.

UNMULLED TESTS: Lowest dry strength was developed at 6 per cent moisture. Highest dry strength was developed at 10 per cent moisture.

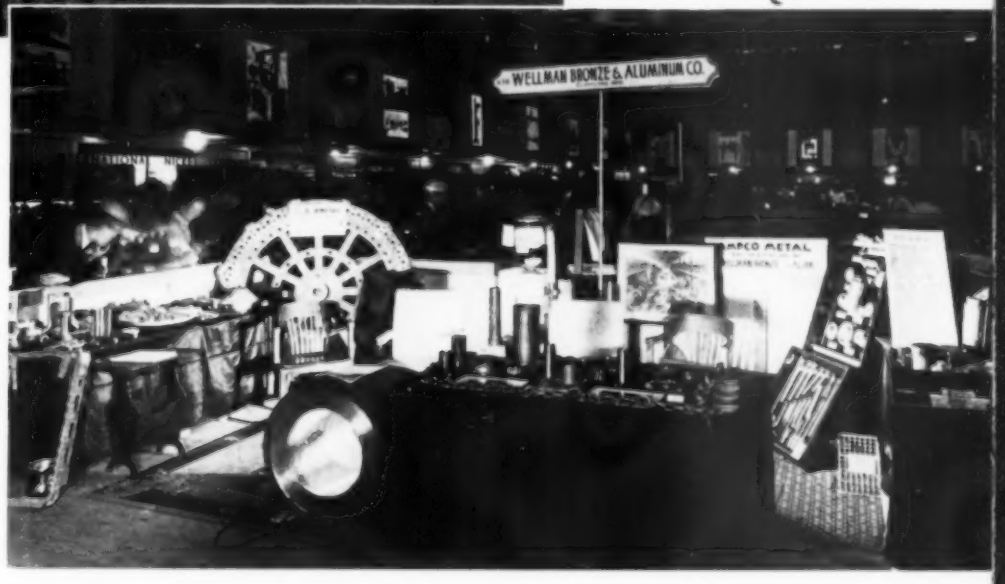
Nonuniform development of green strength of the unmulled tests resulted. A portion of the sands increased green strength with increase of moisture. The remainder showed slight change or decrease of green strength. Variance of clay content did not seem to explain the uneven development of strength (*Please turn to Page* 67)

Change in Strengths Resulting from Mulling

Moisture	Unmulled	Mulled
GREEN TENSILE		
6%	5.0 ounces	12.2 ounces
8%	5.5 ounces—increase from 6% moisture of 10%	10.2 ounces—decrease from 6% moisture of 16%
10%	5.7 ounces—increase from 6% moisture of 14%	8.8 ounces—decrease from 6% moisture of 28%
DRY TENSILE		
6%	33.9 ounces	129.4 ounces
8%	78.1 ounces—increase from 6% moisture of 130%	200.5 ounces—increase from 6% moisture of 55%
10%	149.2 ounces—increase from 6% moisture of 340%	284.6 ounces—increase from 6% moisture of 120%
GREEN COMPRESSION		
6%	5.0 pounds	9.0 pounds
8%	5.4 pounds—increase from 6% moisture of 8%	7.6 pounds—decrease from 6% moisture of 16%
10%	5.2 pounds—increase from 6% moisture of 4%	6.4 pounds—decrease from 6% moisture of 29%
DRY COMPRESSION		
6%	20.0 pounds	66.0 pounds
8%	46.0 pounds—increase from 6% moisture of 130%	105.0 pounds—increase from 6% moisture of 59%
10%	85.0 pounds—increase from 6% moisture of 325%	146.0 pounds—increase from 6% moisture of 121%

FULTON FOUNDRY & MACHINE CO., Cleveland, showed a number of interesting examples of Meehanite castings. Broken specimens and micrographs illustrated structures, while test data and bars stressed important physical properties. This is the second appearance at a Machine Tool show for the Fulton company, which also maintains a permanent exhibit at its plant.

LAKE CITY MALLEABLE CO., Cleveland, attracted remarkable attention with a wide variety of shock proof malleable iron castings and with several tests showing dramatically certain physical properties. The scale at the end was used for tension and compression tests using a malleable iron flamingo for the test piece. Torsion and ductility tests were made.



WELLMAN BRONZE & ALUMINUM CO., Cleveland, displayed an exceptionally large number of different types of nonferrous castings. A number of these were made of Downmetal, a magnesium alloy, while others were of Ampco metal, an aluminum bronze, suitable for a wide field of applications.

Castings Feature Machine Tool Show

CRAFTSMANSHIP, which to an important degree made possible the National Machine Tool Show held in the Public Auditorium Cleveland, Sept. 11 to 21, should be a source of great pride to the foundry industry. Fully 90 per cent of the machines shown at that tremendous exposition, covering five acres of exhibits, were produced in greater part with castings. Truly, the foundryman's art, as exemplified from the simple pieces to the most complicated shapes, was the basic material for the construction of *(Please turn to Page 76)*

Dry Polishing Specimens

Winner of Second Prize in The Foundry's Award Contest

MANY changes have taken place in the foundry industry during the past 5 years. Guess work in the casting of metals has been eliminated, and in its place scientific methods of control are being used. The metallurgist and the laboratory are becoming more important daily as competition in the casting industry becomes keener. A casting that brings a profit to the manufacturer today must be a product scientifically made.

While the metallurgical microscope is an important piece of equipment in any routine or research metallurgical laboratory, without a suitable method for polishing specimens to be examined, the microscope is of no use. In fact the old methods of fracture examination are just as good as an inferior polishing method.

Of all the commercial metals, gray cast iron is the most difficult to polish and still retain its true structure. Gray cast iron is unique in that it contains a friable constituent called graphite. It is that constituent along with other nonmetallic inclusions that makes the preparation of a specimen of gray iron so difficult. A specimen prepared without its graphite and nonmetallic inclusions intact is of little value to the metallurgist.

The polishing method described in this article was developed for gray cast iron, and afterward applied to white cast irons, steels and nonferrous alloys. The polishing method is quick, economical and can be put into practice by any met-

Fig. 1—Specimen ground with 000 metallographic paper, x100, unetched. Fig. 2—Same field after correct dry polish, x100, unetched. Fig. 3—Same field as Fig. 8 wet polished, x100, unetched. Fig. 4 Sample polished on a wet wheel, x100, unetched

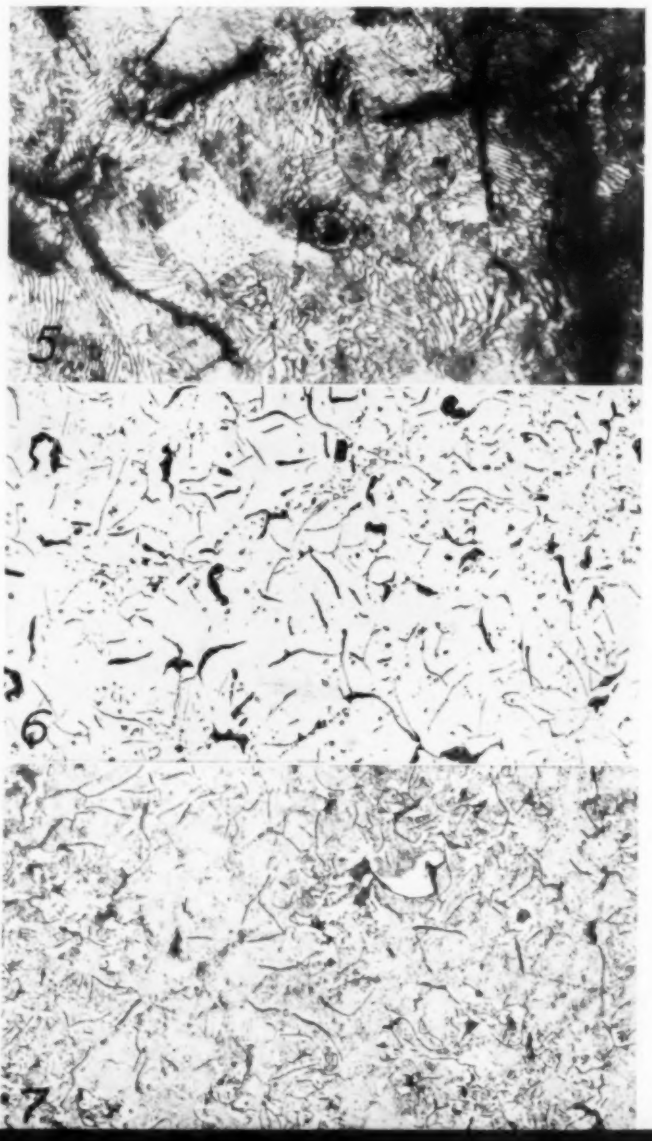


Fig. 5—Effect produced by etching a wet polished surface, x500. Fig. 6—Dislodged flakes lying close or nearly flat on polished surface, x100, unetched. Fig. 7—Same condition on etched surface, x100

for Microscopic Examination

By KENNETH H. PRIESTLEY
Eaton-Erb Foundry Co., Vassar, Mich.

allurgist or practical foundryman who has a knowledge of metallography. The following is a description and discussion of the procedure used by the author.

Any type of horizontal polishing stand with interchangeable disks and a running speed of 400 to 600 revolutions per minute is suitable. A friction drive is not recommended. The disk should run smooth and not be jumpy.

The preparation of the specimen for polishing is quite important if good results are to be expected. A representative sample about $\frac{3}{8}$ x $\frac{3}{8}$ x $\frac{3}{4}$ inches is cut. The surface to be polished which is $\frac{3}{8}$ x $\frac{3}{4}$ inches is milled or filed very true. The preliminary polishing is accomplished by progressively using number 1G, 1, 0, 00, and 000 metallographic paper or any other type of emery paper of similar grades.

The file or mill marks are removed by drawing over number 1G paper on a plate of glass. The piece always should be drawn perpendicular to the previous scratches. It is important all previous scratches be removed. The operation proceeds in the same manner, using papers number 1, 0, 00, and 000. The specimen now is ready for the final polish which is done on a velvet covered disk using No. 288 Bausch and Lomb rouge cast in a stearic acid base as an abrasive or polisher. The wheel is well charged with the abrasive and dampened with water just enough to lubricate the specimen. The specimen should be rotated slowly through

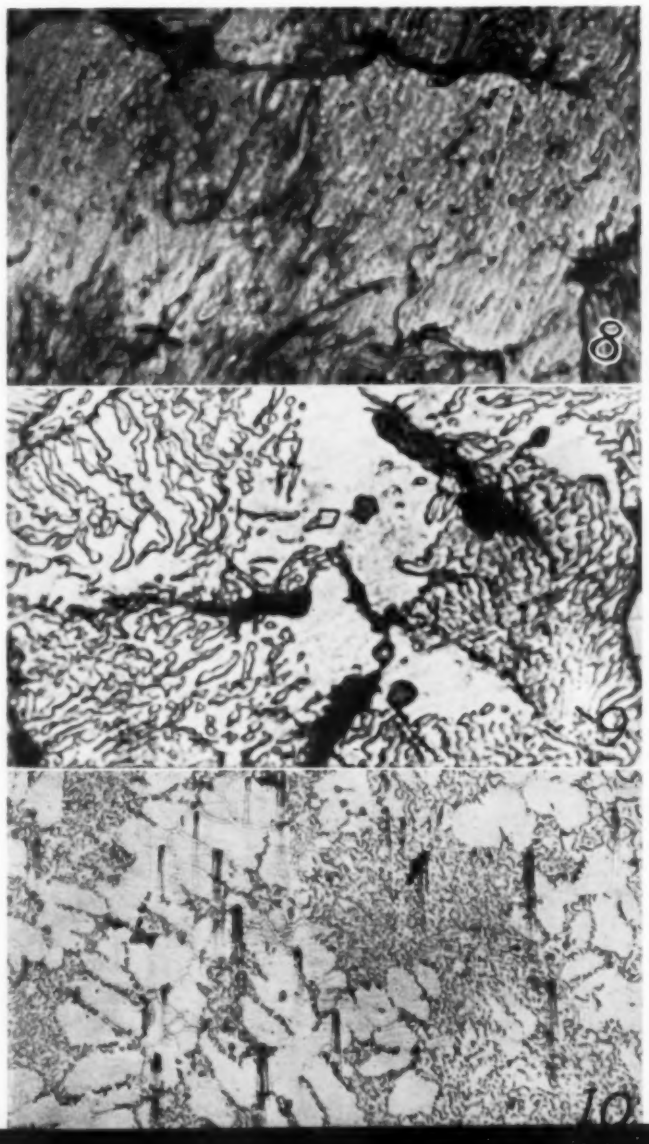
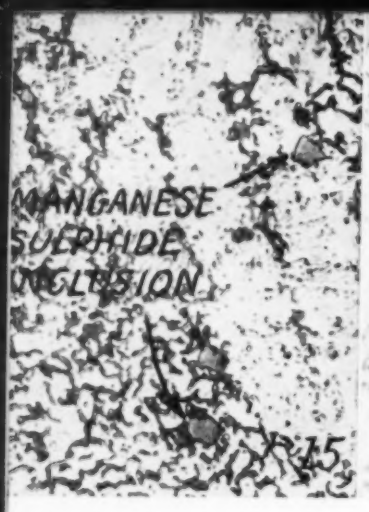


Fig. 8—Metal of the matrix lapped over graphite, x2800, etched lightly. Fig. 9—Same surface repolished correctly and lightly etched, x2800. Fig. 10—Cometing effect on polished surface, x200, etched

Fig. 11—Irons with large graphite flakes in matrix of pearlite or martensite are easy to polish, x800, etched. Fig. 12—Type of iron which must be dry polished, x800, etched. Fig. 13—Hard iron to polish, x800, etched. Fig. 14—Most difficult type to polish, x800, etched



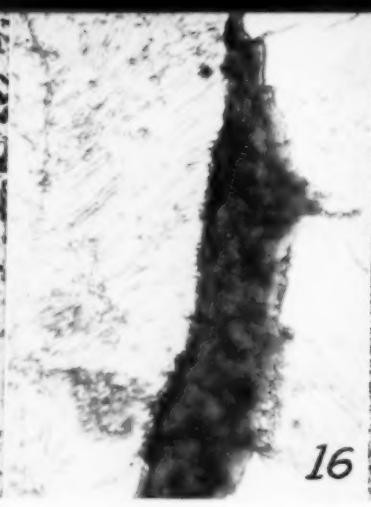


Fig. 15—Manganese sulphide inclusions in iron, x800, etched. Fig. 16—Large graphite flake in a matrix of pearlite, x800, etched. Fig. 17. — High carbon, high silicon iron cast against a chill, x100, etched

about a 90 degree angle while polishing. The specimen is polished until all grinding marks are removed, but must not be over polished. It is important that there be no grit left on the surface after preliminary polishing. It is well to wash the specimen thoroughly before beginning the final polish.

The following is a discussion of the methods with minor details.

It was observed that the graphite flakes and inclusions were only gouged out during the final polishing. Fig. 1 shows a specimen as it comes from the last step of preliminary polishing. The specimen had just been ground on a 000 metallographic paper. Notice the graphite flakes are intact. Fig. 2 shows the same field after a correct final dry polish, which holds the graphite flakes in. The final polish in this case has still been a grinding action, cutting through the graphite flakes instead of hooking them out and at the same time leaving a very well polished surface free from scratches.

Fig. 3 shows the same field as Fig. 8 polished 10 seconds on a broadcloth wheel using levigated alumina and water. Observe that after the short polish on a final wet wheel that practically all the graphite flakes are gouged out leaving enlarged cavities behind. Once these cavities are formed it is found that the dragging action of the polishing powder on the borders causes the cavities to grow until they attain an apparently critical size, beyond which the rate of growth is negligible.

Fig. 4 shows a micrograph of a sample polished on a wet wheel. The sample was not etched and the micrograph taken at 100 diameters. Compare the condition existing on the surface of this specimen with that in Fig. 2. What is supposedly graphite in Fig. 4 is only black cavities as compared with the graphite flakes in Fig. 2 which are the normal gray color of graphite when examined under microscopic conditions.

The effect produced by etching a wet polished surface is shown in Fig. 5. The micrograph was taken at 500 diameters. The other constituents such as pearlite and phosphorus eutectic are shown but the smeary effect of the graphite having been ripped out camouflages the true structure of the iron. Part of one of the graphite flakes is still intact, and shows what the true structure would be like.

Attention must be called to the fact that even in carefully prepared specimens a number of cavities always occur. A few of these are due to porosity of metal, but the vast majority are produced by dislodging flakes that lie close and nearly flat on the polished surface and are too shallow to stand much abrasion. Fig. 6 shows this condition existing in an unetched specimen and Fig. 7 the same condition on an etched surface.

Care must be taken when using the final wheel that the metal of the matrix is not lapped over the graphite. Fig. 8 shows this condition existing on the surface of a specimen. The sample was etched lightly, and photographed at 2800 diameters. Notice how the metal has been worked, and at the same time flowed or lapped over the graphite. This condition is hard to avoid if the nap of the velvet is badly worn. Fig. 9 shows the same surface repolished correctly and lightly etched. The illustration also was taken at 2800 diameters. Notice how clearly the graphite stands out, and also the condition of the matrix. It is hard to believe that it is a micrograph of the same iron. Irons containing finely dispersed graphite are susceptible to this condition. The

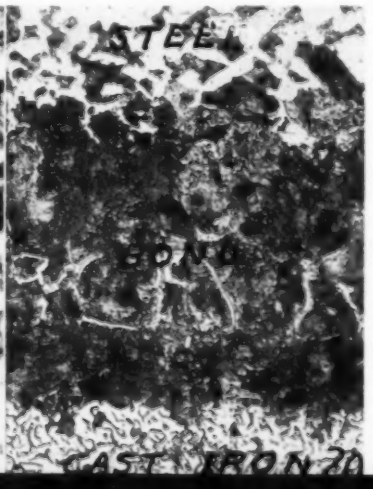


Fig. 18—Chill cast iron, x800, etched. Fig. 19—Same as Fig. 18, x2000, etched. Fig. 20—Centrifused cast iron, x200, etched

Kenneth H. Priestley

graphite in this case was finely dispersed in a matrix of pearlite. Another undesirable condition that presented itself in the final polish was the cometing effect on the polished surface. Fig. 10 shows this condition very well. It was found that these comets had their source at a deep scratch from the previous grind, and also at points where small graphite flakes had been hooked out. This condition was remedied by slightly rotating the specimen back and forth through approximately a 90 degree angle. This gives splendid results providing the final wheel is not scratching. If it is a worse condition than the first is produced. Consequently, considerable care must be exercised in performing that operation, and in observing the action of the wheel.

Not all specimens of gray iron polish alike. Some are much easier to polish than others. Cast irons with large graphite flakes in a matrix of pearlite or martensite are polished most easily. This type of iron is shown in Fig. 11. With care this type of iron may be wet polished and retain graphite, and more especially an iron with a martensitic matrix. Fig. 12 shows an iron which is fairly easy to polish. This type of iron must be dry polished to retain any graphite, since wet polishing tears out all the graphite. The larger the graphite flakes the easier to dry polish.

Some Types Hard to Polish

Fig. 13 shows a rather hard iron to polish. Rather small graphite flakes in a matrix of pearlite and ferrite is rather difficult to polish. The most difficult iron to polish is one which contains very friable finely dispersed graphite in a matrix of pearlite, ferrite, or both constituents together as a matrix. That type of iron is shown in Fig. 14. Black heart malleable irons are just as difficult to polish and retain graphite, due to the fact that the temper carbon is in the form of nodules in a matrix of ferrite. Interesting examples of that type of iron are shown in Figs. 21 and 22.

In summarizing there are seven factors which determine whether a final polishing wheel is suitable for retaining graphite and presenting the true structure of the iron in the matrix. The following are determining factors with comments.

1. Amount of water used. Should be a minimum and still lubricate the specimen thoroughly.

2. Speed of the smooth running disk. Should be between 400 and 600 revolutions per minute.

3. Pressure of the specimen on the wheel. Should be light as possible and still remove the previous scratches. Watch out for lapping or buffing action.

4. Type of abrasive. Should be a very good grade of rouge.

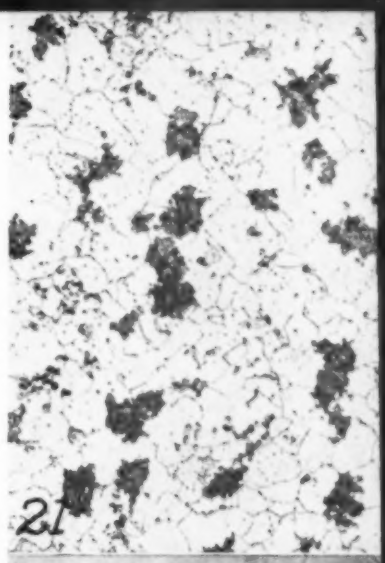
5. Type of cloth. Should be a good grade of medium nap velvet.

6. Rotation of specimen. Should be rotated to prevent cometing effect.

7. Amount of abrasive on wheel. The wheel should be well charged with the abrasive.

A certain amount of experience and skill is necessary before the best results can be obtained, particularly in the preparation and use of the final wheel. Once these are gained it will be found that the method is rapid, yields consistently good results with all types of gray irons, and can be just as advantageously applied to other metals. It is strongly recommended for preparing steel samples that are to be examined for nonmetallic inclusions. Fig. 15 shows manganese sulphide inclusions in iron. These are also easily dislodged, but by the present method they can be preserved intact, irrespective of size or composition; thus giving a true picture of the cleanliness of

(*Please turn to Page* 72)



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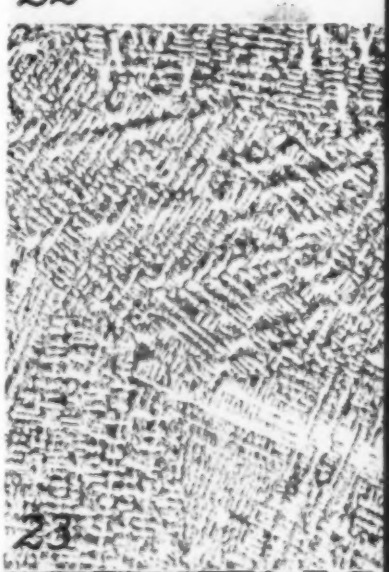

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Fig. 21—Black heart malleable iron, x100, etched. Fig. 22—Temper carbon nodule black heart malleable iron, x800, etched. Fig. 23—Heat resisting austenitic steel cast in permanent mold, x100, unetched. Fig. 24—Micrograph of bars, 80 per cent zinc, 20 per cent copper, cold worked and annealed, x12, etched

Fig. 1—Pouring high-test, nickel alloyed iron from two ladles for a large lathe bed casting

The Buyer's Views On Foundry Problems

By D. M. GURNEY

Metallurgist, Warner & Swasey Co., Cleveland

OBTAINING castings of sufficient quality and accuracy is an ever present problem of manufacturers of machine tools. To be capable of maximum performance, machine tools require a degree of finish and accuracy demanded by few industrial products. The Warner & Swasey Co., Cleveland, machine tool manufacturer, many years ago realized that excellent castings are a prerequisite to the manufacture of good machine tools. Its experience in this respect may be of interest to other manufacturers.

The Warner & Swasey Co. always has bought its gray iron castings from outside foundries. Its early experience doubtless has paralleled that of other purchasers whose requirements, although amounting at times to several hundred tons a month, are hardly large enough to warrant a foundry of its own. Usually there was a discrepancy between what the purchaser wanted and what the foundrymen said could be produced—at any price. The result was a disheartening number of rejected castings, replaced by the foundry, but on which hours of direct labor had been expended before a hidden defect was discovered.

Fig. 2—All large machine tool castings are rough ground on surfaces which are not to be machined, then painted

Some types of castings were more susceptible to defects than others. Frequent conferences of designers, patternmakers, and foundrymen had worked out ideas whereby the percentage of scrap was held to a moderate figure, but a few castings seemed to resist all efforts. In these, where as high as 80 per cent rejects would be encountered, the designers had to devise a construction in which the common defect could be localized or repaired in such a way that it would not cause subsequent trouble.

One such casting, a thick-walled turret, eventually was turned over to a small foundry in Wellington, O., specializing in machinery castings, whose representative was willing to try the "toughest piece in the shop." The first shipment of these proved to be entirely sound and free from internal porosity usually found in the thick turret walls. The explanation, that it was done mainly by building a chill into the core so that the solidification rate was controlled, indicated that the general superintendent was using ingenuity and skill to much better effect in producing castings than his competitors.

From this first contact, the Sterling Foundry Co., Wellington, O., was given an increasing share of the business. The fact that in over a year's time the per cent of rejected castings is 0.52 per cent of all receipts (about one in 200) is sufficient warrant to describe foundry operations at that plant.

Samuel Hummel, who was superintendent of the foundry at the time it began to make castings for Warner and Swasey, was a man of wide experience in foundry work. He believed that the average molder is spoiled for the highest grade of work because he is not furnished enough of the best materials and equipment, and that his supervisors have constantly driven him for production rather than quality. Consequently, Hummel early turned to the white residents in Wellington, a small agricultural center near Oberlin, and the villages within a 10-mile radius.

Trains Men for Foundry

He was able to recruit a sufficient number of farm-bred young men, intelligent Americans, and trained them thoroughly, each for his own job. These men are the type who take pride in owning their homes. Practically all of them have kitchen gardens and small orchards and are reasonably independent of fluctuations in the business cycle. Some of them operate sizable farms. This requires more aggressiveness and far more stability than is possessed by the ordinary "pay-day" worker.

It was not an easy matter to train a hundred of these men. It was a long, tedious job, but the results have warranted the trouble. Each one now is a specialist in his own department, but with the idea of team work always in mind, believing that if he does his part well the final casting will be perfect. Piece rates never have been established, since they favor haste rather than craftsmanship. Dignity and mutual respect characterize the relations of management and workmen in this small foundry.

It would not be easy to overemphasize this phase of the operation. The human factor is paramount in foundry work where production is too diverse for a high degree of mechanization and standardization. In this particular plant the human element fortunately has been controlled by an able foundryman and executive who is also a born teacher of his craft. The happy result is that "labor turn-over" is no problem at all.

Shortly after contracting

Fig. 3—Careful proportioning of the charge is essential to proper control of the analysis of the casting

for the Warner and Swasey work, Mr. Hummel took his entire force, down to the youngest apprentice, into Cleveland for a thorough inspection of the main factory and a series of talks by various executives, so that they could get first-hand information on what was expected of their iron castings. Since then, departmental foremen frequently have interchanged visits to keep this idea alive.

High grade pattern making is, of course, essential. This is taken care of at the Warner and Swasey plant in Cleveland. The foundry expects to get accurate patterns, and then makes every effort to keep them in the best possible condition.

A high grade pattern (*Please turn to Page* 75)

Fig. 4—Lathe bed castings have close tolerances as to size, contour and surface finish

GRAY CAST IRON

By JOHN W. BOLTON

Chapter V (Effect of Sulphur)

THE common form of sulphur, namely yellow sulphur, stable below 205 degrees Fahr., crystallizes in the rhombic system. It melts at 235 degrees Fahr., has a specific gravity of 2.06 and an atomic weight of 32.06. Sulphur in pig irons is derived from the burden, due to the absorption of sulphides, such as FeS_2 (pyrites), and the reduction of sulphates to sulphides and consequent absorption. It has been noted that furnace conditions which promote high silicon content in the iron tend to keep the sulphur low, and vice versa. The sulphur absorption of the blast furnace slag increases as the temperature and basicity of the slag are increased.

The iron-sulphur diagram of Trieschke and Tammann shown in Fig. 68 indicates that at room temperatures under conditions of equilibrium, the material consists of iron and free iron sulphide. Works of other investigators suggest that this iron contains a small percentage of FeS in solid solution. However, at moderately elevated temperatures, 266 degrees Fahr., the iron and iron sulphide form a solid solution.

Is Hard and Brittle

Ferrous sulphide, FeS, is described as a hard brittle substance, composed of about 56 parts iron and 32 parts sulphur. Its melting point is given as 2140 degrees Fahr. by Friederich and 2125 degrees Fahr. by Shibata. Its specific gravity is 5.02 (Holman).

The eutectic of iron-iron sulphide consists of 85 per cent FeS and 15 per cent Fe. Its solidification point is given as 1760 degrees Fahr. to 1783 degrees Fahr. by various investigators.

The FeS-MnS system has been investigated by Rohl and later by Shibata. The diagrams are shown under chapter on manganese, THE FOUNDRY for September.

The first complete investigation of the iron-iron carbide—iron sulphide system apparently is that of Tomo-o-Sato—*Tetsu to Hagane*, November, 1931, Vol. 17, pages 1126-1149. This includes thermal and microscopic analyses of some 75 alloys. The projection diagram Fig. 70 has been constructed.

The diagram is the central triangle. The lower attached section represents the Fe-FeS diagram, which incidentally agrees with previously published binary diagrams of this system. The regular iron-carbon (iron-iron carbide) diagram is shown, upper left. The Fe_3C-FeS diagram (upper right) has been deduced from the diagrams of the ternary system. These diagrams indicate that sulphur, as FeS is slightly soluble in the iron and iron-carbon alloys. If the deduced Fe_3C-FeS diagram is correct, the illustration indicates slightly greater solubility of FeS in Fe_3C than in Fe.

Direct experiments by other investigators have not established, other than accidental, occurrence of FeS in Fe_3C in a fully satisfactory manner. However, the consensus of opinion seems to be that small amounts of FeS in Fe_3C add greatly to the stability of the Fe_3C. The separation of Fe_3C without decomposition involves grave experimental difficulties. Tomo-o Sato found a ternary eutectic of gamma Fe-FeS and Fe_3C separating at 1775 degrees Fahr.

Gives Eutectic Separation Temperature

The iron-iron carbon-iron sulphide system had been partially investigated previously by Hanemann and Schildkotter—*Archiv fur Eisenhuttenwesen*, 1929-1930, Vol. 3, pages 427-435—and by Vogel and Ritzan—*Archiv fur Eisenhuttenwesen*, May 1931, Vol. 4, pages 549-556. According to Vogel and Ritzan the ternary eutectic separates at 1787 degrees Fahr. and contains 0.15 per cent carbon and 31 per cent sulphur.

All investigators found that the temperature of the pearlitic transformation is not materially influenced by the presence of sulphur.

In promoting the decomposition of iron carbide (cementite, Fe_3C) silicon may be said to oppose the effects of iron sulphide. This was commented upon by early investigators. From time to time formulas have been advanced to indicate the percentage of silicon required to offset the effects of sulphur. Obviously these are without scientific basis, because other factors

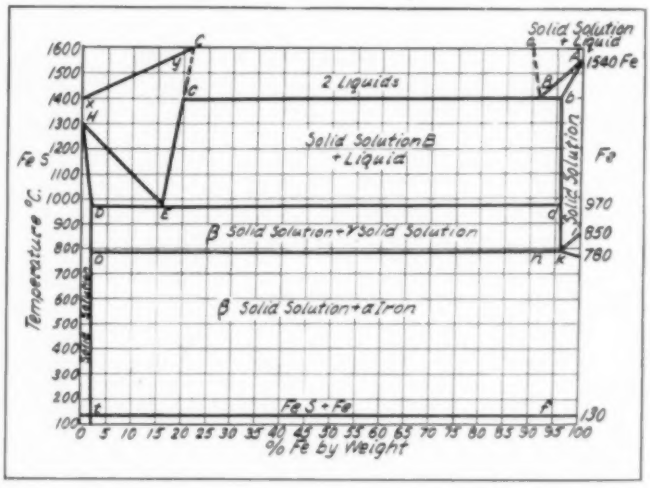


Fig. 68—Equilibrium diagram of the iron sulphur system according to Treitschke and Tammann

involved are not given any consideration.

As noted previously the presence of FeS increases markedly the stability of the carbide in the pearlite. Effects of manganese on sulphur have been considered in the preceding chapter.

For many years sulphur was considered a source of all evils in the iron foundry, and great attention has been given the so called sulphur problem. In the chapter on manganese, and remarks on sulphur formations in preceding paragraphs the major reactions of sulphur in the iron, carbon, silicon, manganese alloys have been outlined.

Is there a serious sulphur problem in the modern iron foundry? In the opinion of the author there is not.

First of all in the presence of sufficient manganese, practically all the sulphur in irons of ordinary sulphur content, say about 0.10 per cent, occurs in the only mildly detrimental form of manganese sulphide inclusions. The volume of such inclusions in an iron 0.10 per cent sulphur is about 0.50 per cent. These manganese sulphide inclusions do not form weak networks throughout the metal, and apparently are less effective than an equal volume of graphite flakes in interfering with the tenacity of the metallic matrix.

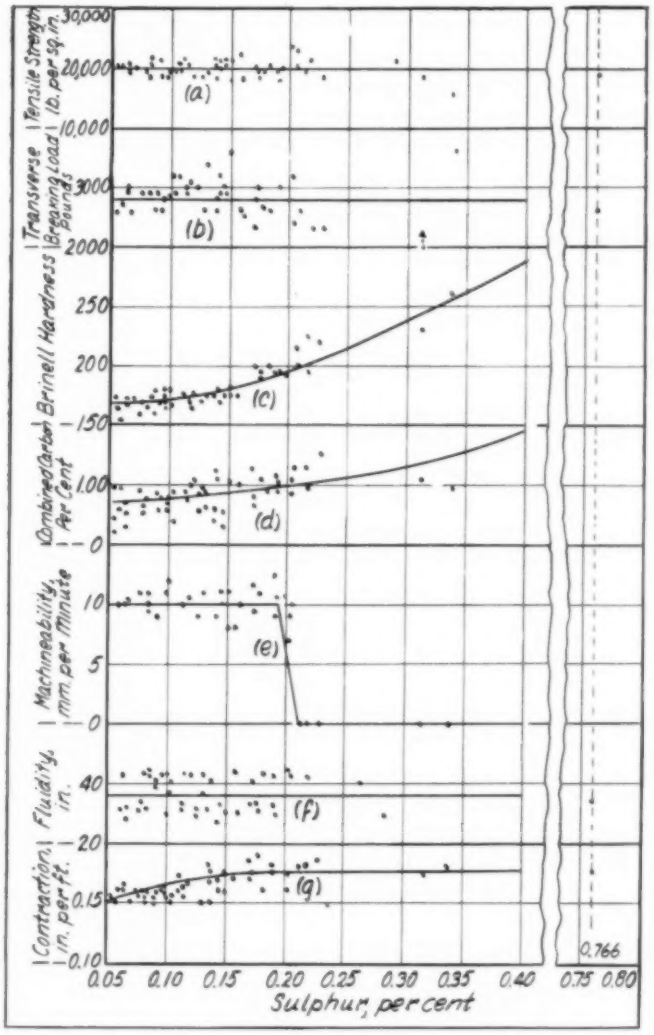


Fig. 69—Results of tests on the effect of sulphur in gray cast iron, as prepared by Smith and Riggan

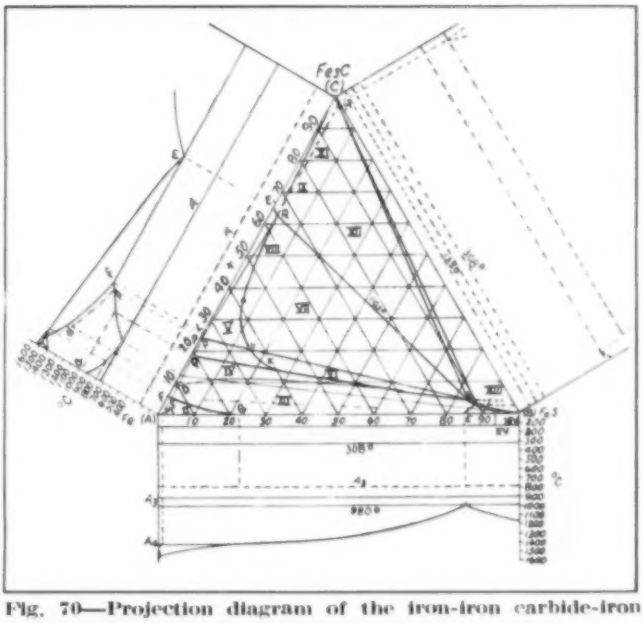


Fig. 70—Projection diagram of the iron-iron carbide-iron sulphide system with three binary equilibrium diagrams attached, according to Tomo-o Sato

Second, excessive sulphur content can be avoided. This will be referred to later.

In his electric furnace researches, Elliott—*Transactions* American Foundryman's Association, 1921, Vol. XXIX—produced metal as low as 0.009 per cent sulphur, by basic slags. This practical elimination of sulphur apparently did not in itself produce any startling benefits.

Dispel Evil Effect Theories

Advent of high test irons did much to dispel the theories of sulphur's alleged evil effects. A brief tabulation of high test results, made by the author a few years ago revealed that a large percentage of high strength irons had sulphur contents ranging well above 0.10 per cent and up to 0.20 per cent, or more. The high sulphur content was more or less incidental, but did show that very good material could be made with sulphur content beyond the usual specification limits.

To be sure with improper sulphur manganese balance, an excess of sulphur tends to stabilize the carbides. This might be well and good and sulphur could be employed somewhat as is chromium, were it not for the tendency of free iron sulphide to form weak brittle networks. Manufacturers of white and chilled irons have made some use of the carbide stabilizing tendencies of sulphur. Within the past few years steel makers have utilized sulphur, in the form of zirconium and titanium sulphides in production of free cutting steels of quite respectable physical properties. Selenium, an element quite closely related to sulphur, has been used for similar reasons.

It is claimed—United (*Please turn to page* 78)

Table I

Grain Fineness Classification For Molding Sand

Grain Class	Grain Fineness Zone
No. 1	200 to 300
No. 2	140 to but not including 200
No. 3	100 to but not including 140
No. 4	70 to but not including 100
No. 5	50 to but not including 70
No. 6	40 to but not including 50
No. 7	30 to but not including 40
No. 8	20 to but not including 30
No. 9	15 to but not including 20
No. 10	10 to but not including 15

Table II

Clay Content Classification For Molding Sand

Clay Class	Clay Content Zone			
A	0.0 per cent	to but not including	0.5	per cent
B	0.5 per cent	to but not including	2.0	per cent
C	2.0 per cent	to but not including	5.0	per cent
D	5.0 per cent	to but not including	10.0	per cent
E	10.0 per cent	to but not including	15.0	per cent
F	15.0 per cent	to but not including	20.0	per cent
G	20.0 per cent	to but not including	30.0	per cent
H	30.0 per cent	to but not including	45.0	per cent
I	45.0 per cent	to but not including	60.0	per cent
J	60.0 per cent	to but not including	100.0	per cent

Table III

Fineness Test Data for a Coarse Molding Sand

On Screen No.	Per cent clay substance 8.10
6	Per cent sand grains caught 0.64
12	Per cent sand grains caught 28.75
20	Per cent sand grains caught 20.98
40	Per cent sand grains caught 16.16
70	Per cent sand grains caught 20.38
100	Per cent sand grains caught 3.06
140	Per cent sand grains caught 0.60
200	Per cent sand grains caught 0.20
270	Per cent sand grains caught 0.28
Pan	Per cent sand grains caught 0.60

Table IV

Calculations for Obtaining Grain Fineness Number

Mesh No.	Per Cent Sand Remaining on Screen		Multiplier	Product
On 6	0.64	×	3	1.92
On 12	28.78	×	5	143.90
On 20	20.98	×	10	209.80
On 40	16.16	×	20	323.20
On 70	20.38	×	40	815.20
On 100	3.06	×	70	214.20
On 140	0.60	×	100	60.00
On 200	0.20	×	140	28.00
On 270	0.28	×	200	56.00
On Pan	0.60	×	300	180.00
Total Sum	91.68		Total Product,	2032.22

$$\frac{2032.22}{91.68} = 22 \text{ or No. 8 Grain Class}$$

Molding Sand Characteristics For Nickel Bronzes

By DAVID M. CURRY
International Nickel Co., New York

UNTIL a few years ago, guess work was the trend in conditioning molding sands used in the casting art, but at present sands are purchased by specification much like metal and other materials.

Feeling the need for certain standards governing testing and grading of molding sands, the board of directors of the American Foundrymen's association, on Feb. 8, 1921, acted upon past recommendations of a special committee, to select a group of men well known in the industry to formulate a set of standards whereby foundrymen would be able to select a sand suitable for their own applications.

Committee Formulates Standards

The initial project served the following purposes:

1. To collect all information available in technical literature on these subjects in this and foreign countries.
2. By field operations of a practical technical assistant to study and formulate the practice in the best foundries in the country.
3. To submit all information so obtained to a committee composed of practical foundrymen and technical experts. This committee to formulate suggestions for promising lines of research that might be followed to attain the desired ends.

A definite set of rules for testing and grading various sands suitable for castings was the final result of that commendable undertaking and every foundry large or small can profit by adherence to these standards as set down and approved by the American Foundrymen's association. While there are many physical properties of molding sands, the following are the most important: Moisture content; permeability; strength; fineness; refractoriness.

A good molding sand should be refractory, that is, capable of withstanding the heat of molten metal. It should be porous to allow the escape of gases in the mold and also it should contain a certain amount of clay to give it bond or strength besides having an even grain size.

All of these properties will vary according to the class of work for which the sand is intended.

Two important elements in molding sands are silica, which is a heat-resistant substance, and alumina or clay which makes up for the bonding quality. Other elements found in natural molding sands are iron oxide, calcium oxide, magnesia, soda, potash, manganese oxide, etc. Silica alone is the fire-resistant element, but under heat it combines with these oxides forming silicates. These silicates melt at a much lower temperature than does free silica, therefore those sands carrying a large percentage of other earth matter besides silica will produce castings that are hard to clean. This is called fusion.

Thorough Mixing Important

Combinations of sands to be used should be mixed thoroughly. This applies to all good foundry practice but is applicable particularly in the case of metals which must be poured at high temperatures such as nickel silver, monel metal and the modified alloys of monel metal. For light castings, a fine well vented sand is preferable, whereas for medium castings, a more open sand gives satisfactory results. Most sands usually are known by trade names and it is impracticable to recommend a special grade, but sands suitable for the many applications can be purchased by specification as set down by the committee on molding sand research of the A.F.A.

A sand suitable for light bronze castings can be specified by purchasers as a No. 3E sand. This means that the grain class would be between 100 and 140, and clay content of between 10 and 15 per cent.

The grain fineness classification is given in Table I and the clay content classification in Table II. The fineness test data of Millville, N. J., coarse molding sand is shown in Table III. An example showing calculations for grain fineness number, grain class and clay content class, following A.F.A. directions, is presented in Table IV. This sand has a clay content of 8.10 per cent and therefore would fall into the class D clay classification. This typical sand would be specified and purchased as a No. 8D sand.

A great number of books and papers have been written pertaining to the many characteristics of molding sands, besides the usual work carried on by the molding sand research committee of the American Foundrymen's association. It is not the purpose of this outline to delve into the subject too far, but just enough to show foundrymen that sand is one of the most important tools in the foundry, and with the understanding of the first few fundamentals governing that material, the foundryman will be able to produce a quality casting free from molding sand defects, blows, scabs, etc.

Also, there is on the market sand testing apparatus manufactured by various concerns which has been very useful and has paid for itself many times over. Through a system of daily control worked up and by this method, a great many troubles, attributed to sand, have been eliminated. We have in our foundry at Bayonne, N. J., a complete sand testing laboratory and the time spent on control and testing is well worth while. The apparatus mentioned is manufactured by the Harry W. Dietert Co., Detroit.

As pouring temperatures increase from 2100 to 2500 degrees Fahr., or in the range when nickel silvers are poured, a more open and a more refractory sand is desirable. The permeable range should be from 40 to 60, preferably the high limit.

Higher Permeability Needed

In most castings made of pure nickel or various modified nickel alloys, such as monel metal or high silicon monel, a further increase in permeability is desirable. In that case, permeable sand quality should be close to 100. The molding practice is not unlike that of steel castings. Many foundrymen casting these types of alloys realize this and have purchased sand suitable for the work or have bought sand ready mixed and tempered from a steel foundry.

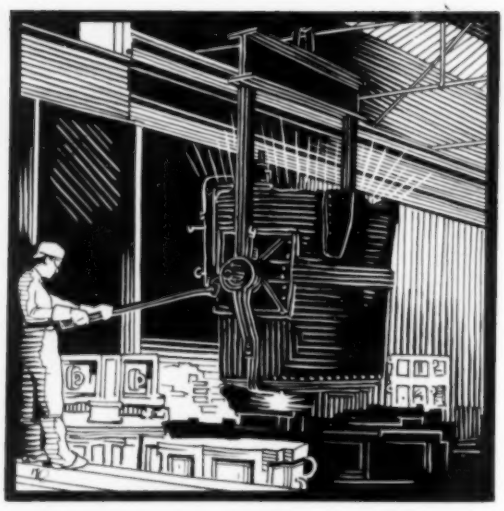
Synthetic sands also have been proven useful for the casting of monel metals or those modified alloys where pouring temperatures are in the range of 2800 degrees Fahr. Sand suitable for this application can be made from clean silica sand of an A.F.A. grain size between 65 and 80, well mulled with 15 per cent by weight of high grade fire clay with the suitable moisture content of 5.5 per cent. The sand can be used in either the green or dry molding practices. In both cases, a mold wash made up of silica flour will have a tendency to produce a clean smooth casting.

Continuous systems (*Please turn to Page* 80)

Table V

Molding Sand Characteristics For Several Metals

	Pouring Temp. Range deg. Fahr.	Permeability A. F. A.	Clay per cent	Green Shear	Dry Shear	Green Comp.	Dry Comp.	Moisture %
Green Sand								
Regular bronzes	1900 to 2200	16–24	8–18	1.4	5	4	40	5.5
Nickel silvers	2250 to 2500	40–60	8–18	1.4	5	4	40	5.5
Natural or Synthetic—Either Green or Dry Sand Molding								
Monel metal	Approx. 2750	60–80	13–18	1.6–2.0	6.5	4–4½	50	6.0
High "S" monel	Approx. 2750	60–80	13–18	1.6–2.0	6.5	4–4½	50	6.0
Pure nickel	Approx. 2750	60–80	13–18	1.6–2.0	6.5	4–4½	50	6.0



Questions and Answers

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Tumbling Barrel Speed Varies with Load Material

We would like to know the usual speed for tumbling barrels and the horsepower required to operate.

Speed at which a tumbling barrel is operated depends largely on the character of the work, while the horsepower required depends upon the loading. The normal peripheral speed for a tumbling barrel is 200 feet per minute. This of course varies with the type of castings, so that with stove plate, the lowest rate of approximately 175 peripheral feet per minute is used. For small chunky work the speed may be increased (peripheral) to 250 feet per minute. Manufacturers state that from 200 to 225 feet per minute may be considered a good average speed.

A round mill loaded full requires 1 horsepower for each 6 cubic feet of tumbling volume. A square mill loaded full requires 1 horsepower for each 8 cubic feet of tumbling volume. The lower horsepower requirements for the square mill result from the fact that cascading the castings is not possible in that type of mill.

Amount of power required for operation increases greatly as the extent of loading decreases. For example, a round mill loaded ¾-full would require four times the power needed for the same mill fully loaded. Although partial loading increases the speed of cleaning, it also increases greatly the cost of maintenance and decreases materially the life of the mill. Therefore, manufacturers of tumbling mills point out that it is essential from the cost standpoint to have the mill fully loaded.

Gates May Cause Cracking On Flange of Aluminum Casting

We are making aluminum boxes 20 x 12 x 6 x ⅜-inches thick, flange on edge ⅞-inch thick and 1-inch wide, using a dry sand core. It is necessary that we use the following mixture: 96 per cent aluminum and 4 per cent copper. We are having trouble with the castings cracking on the flange. This might be caused by the core not being of the proper mixture to give enough to allow the metal to contract in cooling. Would you recommend a core sand mixture that would be suitable for these boxes. Our mixture is as follows: 2 parts of new fine molding sand, 1 part fire sand, 1 part old fine molding sand and 1 to 80 dry bond.

Cracking of the aluminum box at the flange possibly is caused by hard cores and, therefore, a softer core mixture may correct that difficulty. It may also be caused by the temperature condition in the casting resulting from the location of the gates. It frequently happens where an alloy is fractured easily at a red temperature, as is the aluminum alloy, generally sand cast, that the points where the metal enters the mold are so much hotter than the rest of the casting and consequently so much weaker at the time of shrinkage that cracks are present between the gates or even at the gates. By locating the gates elsewhere these cracks may be eliminated in some instances.

Experience has shown that in casting a box, such as the one described, to gate it at the flange around the open side produces cracks in that flange. To arrange the mold so that the gates are at the corner of the closed side has frequently reduced the tendency to crack so much that with a little more care in the uniformity of temperature at which the casting is poured, the trouble practically is eliminated.

To make a softer core, the following changes should be made: Instead of having the ratio of 1 to 3 of new fire sand to fine sand or molding sand, you could use 1 part of fire sand and

2 parts of molding sand. This 2 parts to include both old and new in the proportion of 2 to 1. With this increase in the amount of fire sand and reduction in the amount of close fine molding sand, the amount of binder can be reduced so as to make a very soft core; although this core will be found to be trying from the standpoint of resistance to the abrasion when handling. A ratio of 1 to 100 is ample binder for soft cores if carefully mixed with sand and properly baked.

It is our opinion, without seeing the castings, that the reduction in the hardness of the core may help some and probably does account for many of the defects; but the location of the gates can effect the cracking very materially and should be studied carefully.

Moisture on Steel Tubes Will Cause Blow Holes in Casting

We are making aluminum alloy crankcases containing cast in steel tubes. The aluminum alloy seems to kick away from the tubes, causing hollow spots or blow holes next to the tube. Can you tell us how to overcome that difficulty?

Difficulty with molten metal not lying against the tube surface generally is caused by moisture on the surface or to the fact that the surface is not clean. If the sand is warmer than the tube, there is a tendency for the moisture from the sand condensing upon the colder tube surface. Consequently, the tube should at least be of the same temperature as the sand, but if possible should be warmer, and the mold should not be closed too far in advance of pouring.

If you are sure that the trouble is not caused by moisture collecting on the tube surface, examine the exterior surface of the tubes to see that they are perfectly clean. If any rust spots are present blowing will occur due to the inter action of the molten aluminum and the iron oxide. If you have sandblasting equipment available, it will be ideal for obtaining clean surfaces on the tubes.

Centrifugal Pump Cases Run Over Weight of Estimate

We are making bronze centrifugal pump cases and covers which weigh combined 1900 pounds. This is greatly in excess of the engineering department estimate of 1500 pounds. One explanation for this discrepancy is that the metal is very dense and is poured very hot. We shall appreciate your opinion on the subejct.

Since you do not furnish a drawing or dimensions we are not in a position to check the accuracy of the engineering department estimate. A remote possibility exists that it is in error, but on general principles and basing our opinion on experience we should accept it as correct. The most probable cause of the discrepancy in weight lies either in the pattern or the molding practice. If a close check of the pattern and coreboxes shows that they conform to proper dimensions, then the fault lies in the mold. Either the cope or drag, or possibly both, yield under the pressure of the molten metal and the casting is thicker than it should be.

The obvious remedy is to provide a mold that will not strain, either a dry sand mold in a stiff iron flask, or a green sand mold in an iron flask, or in a wood flask provided with a stiff bottom board and with a strongback on top of the bars in the cope. If the case is molded face down in a green sand mold it will strain possibly ⅛-inch on account of the height of the head above the bottom. For that reason the pattern should be made ⅛-inch thinner than the anticipated casting.

Connecting Rods May Be Used in Making Up Cupola Charge

We shall appreciate your opinion on the advisability of using automobile connecting rods to the extent of 30 per cent in the cupola charge.

Many, probably the majority of automobile connecting rods contain small amounts of nickel and chromium, but the amount is not sufficient to materially affect the composition or physical properties of the iron made from a cupola charge containing 30 per cent of this material. In fact in a general way it may be stated that the character of the metal will be improved.

Gravestone of cast zinc exposed to the atmosphere of Northern Ohio since 1875. The cast panels bearing the inscription are bolted to the sheet metal box. Illustration courtesy New Jersey Zinc Co.

Cavity Is Caused By Shrinkage and Steam

We are sending two defective castings and will appreciate your opinion on whether the cavities are due to shrinkage or steam. The iron mixture was made up of steel 20 per cent, pig iron 35 per cent, plow points 40 per cent and alloys 5 per cent, showing an analysis of: Silicon 2.65 per cent, manganese 0.50 per cent, phosphorus 0.60 per cent and sulphur 0.11 per cent. The molds were made in No 0 Albany sand, but we have no check on the moisture or permeability.

Cavities in both castings are due to a combination of steam and shrinkage, therefore the error is to be charged up against the molding practice. The metal mixture, final analysis and apparently the melting practice are quite satisfactory. In both cases more than the ordinary amount of steam is generated from the water in the sand. This is particularly true in the larger casting containing a large pocket in both cope and drag halves.

Considering each casting somewhat in detail, extra steam generated in the pocket of the small casting occupied a certain amount of space in the mold when it was filled with metal. This steam finally worked its way through the sand and naturally the metal subsided. In the meantime the metal in the gate had frozen thus shutting off the supplementary amount which normally would have flowed in to compensate for the subsidence in the casting.

The defect might have been prevented by venting the pocket with a wire. These extra vents would allow the steam to escape through the sand instead of entering the mold cavity. Alternatively, a riser on the top of the casting would allow the steam to escape through that channel and in addition would insure solid metal in the casting even with a frozen gate. In the larger casting the condition was intensified by the large pockets of sand and the further fact that half the casting was molded in the cope, thus reducing the effective pressure of the metal in the gate. The remedy in this instance is to vent the pockets and raise the sprue 2 or 3 inches.

Pouring Methods Vary in Different Shops

What is the usual practice in American steel foundries in pouring the metal? Is the metal handled in bottom pour or shank ladles?

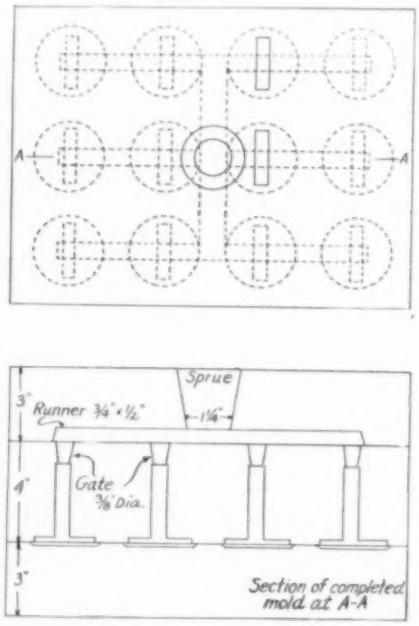
Type of ladle employed in any given foundry depends on local conditions, including the type of furnace in use and the size and weight of the castings. Thus in practically all open hearth shops metal is poured into large and small castings from a large bottom pour ladle. In foundries equipped with bessemer converters or electric furnaces the larger castings in some instances are poured through bottom poured ladles and in other instances over the lip of teapot type ladles suspended from the crane. Nearly all snap flask castings are poured from shank ladles.

Change Position To Prevent Shrinkage

We are having considerable trouble with shrinkage on the top face of a small brass casting. We are forwarding a gate with castings attached and will appreciate your opinion on the cause of the defect.

The immediate cause of the defect on the top face of the highway marker is that in solidifying the heavy stem draws metal from the top plate. The exceedingly thin gates freeze before the casting and consequently cannot supply metal to compensate for the natural shrinkage of the casting. Since the thickness of the casting at the rim prevents the use of a thicker gate the obvious remedy is to mold the castings in the opposite position, that is with the face in the drag and the stem in the cope. A cope at least 6 inches deep and a small riser on top of each stem will produce solid castings.

This is based upon the assumption that you may not want to make any change in pattern or flask equipment. It is the simplest solution for your present problem. However, the present type of gate and the layout of the patterns are highly inefficient. The gate should be on the stem instead of on the rim, and you should have 12 patterns in the flask instead of 6. An improved method of molding these castings is shown in the accompanying illustration. It may be employed either with a matchplate or with a set of loose patterns. A matchplate is preferable since it greatly facilitates the work and pays for itself on a comparatively short order. A second matchplate is required for the second or supplementary cope. This second plate may be either wood or metal. Small projecting members on the face side form the gate impressions on the bottom or joint face of the second cope.



Above—Top view of mold showing arrangement of patterns, spruce, runners and gates. Below—Longitudinal section of mold at *A A*

Pot Core Will Not Float From Bottom

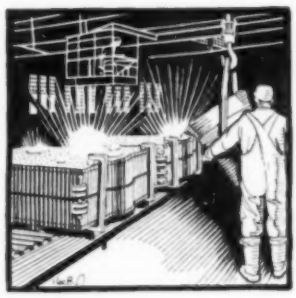
Is there any buoyant force acting on the green sand core of a pot molded mouth down? Does the law "A body immersed in a liquid is buoyed up by a force equal to the weight of the liquid displaced" apply only when the body is completely surrounded by liquid?

The answer to both questions is "No." However, that answer in itself is not quite sufficient since conditions arising in the foundry might lead the inquirer to draw false conclusions without a further knowledge of the subject. For example pots of many shapes and sizes, also other castings in which the interior mound of sand is a continuation of the drag, are cast without anchors or other devices to prevent the core from rising. Occasionally, through any one of many defects in construction, the metal seeps under the core. Naturally, with pressure applied underneath, the core floats away.

Therefore, while the molder reasonably may expect the core to remain in place, the factor of safety prompts him to anchor any core which through shape or size might yield to the pressure of the metal and become dislodged at the bottom and thus admit the molten metal. Where a casting is gated in a manner to cause the metal to rise faster on one side than on the other, grave danger exists that the core will be pushed to one side and lifted. Briefly, under ideal conditions, the lateral pressure of the metal will not move the core.

Quite possibly the second question does not convey your intended meaning. Thus a body immersed in liquid on all sides except the top is buoyed up by a greater force than a similar body completely surrounded, that is with the top also covered. The weight of the liquid on the top counteracts, to some extent, the pressure on the bottom. A particularly illuminating discussion on this subject under the title *Offers Novel Discussion on Core Floating* was presented by John D. Babbitt in the Aug. 1, 1929 issue of THE FOUNDRY.

Viewing Foundry Developments



At Short Range

SILVER bronze, an alloy particularly adapted to interior work, includes a group of alloys consisting mainly of nickel, copper and zinc, the exact proportions being determined by various considerations such as color, corrosion resistance, ease of manufacture. The nickel content lies within the range of 10-20 per cent. Silver bronze takes a fine polish, but looks equally attractive with satin finish. It offers considerable resistance to atmospheric influences and to corrosion, and also may be lacquered.

♦ ♦ ♦

A combination melting and refining unit arranged similarly to a cupola and fired with oil, gas, powdered fuel, contains a water-cooled central block which extends from the reservoir or refining chamber into the throat of the stack so that a ring shaped opening is provided between the two. Patent papers show two sets of burners extending into the stack and refining chamber respectively. Preheated air is obtained from a baffled chamber surrounding the upper part of the stack.

♦ ♦ ♦

CHROMIUM is used in a new steel especially developed for dies used in making aluminum die castings. Five per cent chromium with smaller amounts of tungsten, molybdenum and silicon enable the steel to resist the severe service encountered.

♦ ♦ ♦

A new process of coating iron and steel to render it immune from attack of acids, alkalies and other chemical influences is similar to the nitriding process except that phosphine (PH_3) is used instead of ammonia (NH_3). According to the patent describing it, the temperature employed is below the critical point, and the phosphorus unites with the iron to form iron phosphide on the surface. It is claimed that there is no line of demarcation between the phosphide containing skin which may range from 1/32 to 1/64-inch depending on the length of treatment. While not mentioned, it would be interesting to know how the phosphide case compares with a nitride case for wear resistance.

♦ ♦ ♦

An electrical device, which is installed beneath the kitchen sink for the purpose of grinding waste food and quickly disposing of it through the drain pipe to the sewer system, has been developed by engineers of the General Electric Co. The grinder operates by centrifugal action and shreds all types of waste foods, including bones and other hard substances, with the exception of bottles and cans. Undoubtedly this is another use for castings.

♦ ♦ ♦

IN SELECTION of the proper brick for insulating purposes, it should first be established that the interface temperature between the refractory and the insulating backing wall does not exceed the safe working temperature for which the insulating bricks are recommended. It must be borne in mind that as the refractory lining becomes thinner, due to wear, the interface temperature increases and may even closely approach the operating temperature to which the refractory lining is exposed.

♦ ♦ ♦

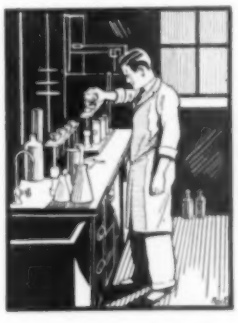
Solubility of copper in cast iron alloys is influenced greatly by the presence of other elements. With from 12 to 15 per cent nickel, as much as 6 to 7 per cent copper is dissolved readily and an alloy containing those proportions of the two elements is one of the important of the austenitic cast iron. Ordinary cast iron will dissolve between 3 and 4 per cent copper.

♦ ♦ ♦

Method of casting flat chain in which it is claimed the joints or hinges are wear, dust and moisture proof recently has been patented by a manufacturer in the Middle West who first incorporated the principle in the design of a snap flask hinge and catch which he manufactures and which have been on the market for some time. The pintle of the hinge or chain is a short length of steel rod enclosed in a bronze bushing. These are placed in the prepared mold where the aluminum for the remainder of the assembly is poured around them.

♦ ♦ ♦

BY HEAT treating and quenching malleable cast iron its tensile strength may be increased to 90,000 pounds per square inch, but its elongation is reduced to 5 per cent according to a recent patent. To attain those properties the castings are heated to 1600 degrees Fahr., quenched in oil, and then reheated to 1325 degrees Fahr. and again quenched in oil. The brinell hardness number is increased to 217. If the castings are heated to 1475 degrees Fahr., quenched in oil, followed by reheating to 1325 degrees Fahr., and quenching in oil the tensile strength is increased to 75,650 pounds per square inch, elongation reduced to 13 per cent, and the brinell hardness increased to 143.



♦ ♦ ♦

A sand producer in the East advocates a change or refinement in the standard A.F.A. method for determining the permeability of sand. He suggests passing the sand through the sieves in the usual manner, then measuring the permeability of each quantity. By comparing the results with the percentages of the total remaining on the sieves a more accurate appraisement may be secured of the permeability, grain size and distribution.

James L. Wick Jr.

E. H. Ballard

Fred L. Weaver

Men of Industry

Whose Activities Are Making Foundry History

JAMES L. WICK JR., president and general manager, Falcon Bronze Co., Youngstown, O., and a director of the American Foundrymen's association, has been elected vice president of the association to fill the vacancy occasioned by the death of Vice President B. H. Johnson. Mr. Wick has been active in the association for many years, serving on committees and as a director.

He was born in Youngstown, O., in 1883 and received his technical training at the Massachusetts Institute of Technology, graduating in 1906 with a bachelor of science degree in mechanical engineering. During summer vacations he worked in the plant of the William Tod Co., Youngstown, now a unit of the United Engineering & Foundry Co.

Following graduation, he became associated with the Youngstown Sheet & Tube Co., and also with the Natural Light & Thorium Co. as assistant superintendent. In 1908 he became general manager and treasurer, Crystal Ice & Storage Co., and designed and rebuilt its plant. He returned to the Youngstown Sheet & Tube Co. in 1918 for a short time as special agent for claims and in 1919 became connected with his present firm, the Falcon Bronze Co., as secretary and assistant general manager. He became president and general manager in 1925.

In addition to membership in the A.F.A., Mr. Wick is a member of the American Iron & Steel institute, American Institute of Mining and Metallurgical Engineers, American Society for Testing Materials and National Founders' association.

E. H. BALLARD, General Electric Co., West Lynn, Mass., has been elected to the board of directors of A.F.A. to fill the unexpired term of Mr. Wick. Mr. Ballard is a past president of the association.

The following members of the board were elected members of the executive committee to serve with the president, vice persident, and executive secretary: FRANK J. LANAHAN, Fort Pitt Malleable Iron Co., Pittsburgh; R. J. TEETOR, Cadillac Malleable Iron Co., Cadillac, Mich.; E. O. BEARDSLEY, Beardsley & Piper Co., Chicago; and W. L. SEELBACH, Forest City Foundries Co., Cleveland.

FRED L. WEAVER became connected with the metallurgical staff of the Great Lakes Foundry Sand Co., Detroit, on Aug. 1. Mr. Weaver was born in Buffalo and received his education in the technical schools of that city. The major portion of his metallurgical training was secured under the direction of Dr. George B. Waterhouse, now at Massachusetts Institute of Technology. Mr. Weaver's experience covers his employment with the Pratt & Letchworth Co., Bethlehem Steel Co., Republic Steel Co., Curtiss Aeroplane Co. For the past 13 years he has been metallurgist and technical superintendent of the Bond plant, American Radiator Co. Mr. Weaver is chairman of the Buffalo chapter of the American Society for Metals.

J. T. DILLON JR., president, Struthers-Wells-Titusville Corp., Titusville, Pa., has been elected president of the Steel Heating Boiler institute. Other officers include HOMER ADDAMS, Fitzgibbons Boiler Co., Ogdensburg, N. Y., and W. R. MEIKLE, vice presidents; and R. A. LOCKE, Middletown, Pa., secretary. Directors include Messrs. DILLON, ADDAMS, and the following: J. R. COLLETTE, Pacific Steel Boiler Corp., Detroit; CHARLES CROUSE, National Radiator Corp., Johnstown, Pa.; R. B. DICKSON, Kewanee Boiler Corp., Kewanee, Ill.; F. B. METCALF, International Boiler Works Co., East Strouds-

(*Concluded on page* 46)

Don't let inertia encumber your business

BUSINESS philosophy associates "inertia" with the ever-debatable policy of "Let well enough alone." Too often this inertia is the result of a groundless fear of upsetting routine, changing specifications and inspection standards, resetting machines, recasting work sheets, ironing out new processing kinks . . . temporarily slowing up production.

Nevertheless, executive and sales heads ever have before them the vital problems of competition and consumer preference. They see clearly the dangers of inertia. But they are not always technicians. Hence, they must look to you — metallurgist, engineer, production expert — to share the responsibility for Progress in raw material and product.

Steel — together with iron, is the basic raw material of American business. Admirable as are many of the more familiar alloying elements for giving steel this or that added quality, inertia threatens when executive, engineer and production manager are "entirely satisfied" and content to ignore the metallurgical progress still being made in alloyed steels. In fact, the past ten years have witnessed some of the greatest of all advances . . . with Molybdenum steels probably outranking all others.

"Moly" not only improves ordinary carbon steel, but actually increases other elements' effectiveness for their particular purposes. This has been proved, times beyond record, in the laboratory, foundry, factory and under every manner of punishing service conditions. Greater strength, toughness, shock resistance, less temper embrittlement, easier machinability, and many other improvements are present in Moly steels and irons. Yet, while bettering the product, Moly seldom adds to the ultimate costs — and usually reduces them.

To engineers, metallurgists and production executives we offer these interesting books: "Molybdenum in 1934" and "Molybdenum in Cast Iron — 1934 Supplement." Also ask us to mail you our periodical news-sheet, "The Moly Matrix." Be free, too, to enlist our Detroit experimental laboratory's help at any time. Climax Molybdenum Co., 500 Fifth Ave., New York.

MOLY

CLIMAX Mo-lyb-den-um

INDUSTRY'S MOST MODERN AND VERSATILE ALLOY

burg, Pa.; H. H. Peek, Lookout Boiler & Mfg. Co., Chattanooga, Tenn.; John Trefts, Farrar & Trefts Inc., Buffalo; and C. N. Tull, Spencer Heater Co., Williamsport, Pa.

Harold S. Austin, formerly metallurgist, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., has been made foundry metallurgist, Buick Motor Co., Flint, Mich.

Frank Liebich has been appointed district manager of the Harnischfeger Corp. in the Detroit territory. Mr. Liebich formerly was connected with the Chicago office of that corporation.

Fred G. Roemer, for the past 20 years superintendent of the Balmer Corp., formerly the Venango Mfg. Co., Franklin, Pa., has been transferred to the Baltimore plant. Operations of the company have been consolidated at Baltimore.

E. J. Gittins, chairman of the board, J. I. Case Co., Racine, Wis., retired recently and resigned as chairman. Mr. Gittins has completed 50 years with that company, starting as clerk at the age of 21. In 1915 he was elected vice president, becoming chairman in 1930.

F. A. Beatty, chief engineer, Lewis Foundry & Machine Co., Pittsburgh, subsidiary of the Blaw-Knox Co., has been appointed vice president of the company. He became connected with the Lewis Foundry & Machine Co. in 1923 as assistant to the chief engineer and in 1927 was made chief engineer.

Ralph R. Teetor, vice president in charge of engineering, Perfect Circle Co., Hagerstown, Ind., has been nominated for president of the Society of Automotive Engineers for 1936.

Alex Taub, development engineer, Chevrolet Motor Co., Detroit, is included among the nominees for councilors.

T. Frank Webster, formerly of the Philadelphia office, Link-Belt Co., has been appointed resident manager of the Boston office of that company, succeeding Horace Goldstein, who has been assigned to engineering sales work in the Philadelphia office. Mr. Webster formerly was resident manager at Pittsburgh.

M. J. Van Leeuwen has joined the sales department of the George G. Isbester Co., Chicago, representative of Yale & Towne Mfg. Co., Philadelphia, and will be engaged in the sale of electric trucks, tractors and other products. For the past 7 years Mr. Van Leeuwen had represented the Rowan Controller Co., Baltimore and the Nichols-Lintern Co., Cleveland, in Chicago.

John D. Swain has been elected vice president of the Electro Metallurgical Sales Corp., New York. Mr. Swain has been vice president of the Linde Air Products Co. and the Union Carbide Sales Co., which are other units of the Union Carbide & Carbon Corp., having been connected with these units for 20 years.

John D. Swain

Robert R. Snow, formerly connected with the Chrysler Corp., Detroit, has been made foundry superintendent of the Pontiac Motor Co., Pontiac, Mich. That firm recently reopened its foundry. Mr. Snow previously was connected with the Beardsley & Piper Co., Chicago, and the Taylor & Boggis Foundry Co., Cleveland.

Henry Butler Allen, metallurgist, Henry Disston Co., Philadelphia, and a member of the board of managers, Franklin institute, has been elected director of the museum of the Franklin institute.

Dr. Howard McClenahan has been granted a year's leave of absence because of ill health, and will continue as secretary of the institute, a position which he has occupied since 1925.

Plans for the reorganization of the Kutztown Foundry & Machine Co., Reading, Pa., whereby the foundry will be operated by the Kutztown Foundry & Machine Corp., were approved by court action recently.

Hear Discussion On Selling Castings

Approximately 125 members and guests attended the opening meeting of the Northeastern Ohio Chapter of the American Foundrymen's association held Sept. 19 at the Cleveland club, Cleveland. Walton L. Woody, National Malleable & Steel Castings Co., and chairman of the chapter, presided. Following the dinner, the chairman called upon Dan M. Avey, president of the A.F.A. to explain the new policy adopted by the association relative to the acquisition of new members by the various local chapters. Mr. Woody announced that Fred S. Wellman, Wellman Bronze & Aluminum Co., had been elected a director for a two year term to fill a vacancy. He then introduced Russell F. Lincoln, Osborn Mfg. Co., and secretary-treasurer of the chapter, who gave a coffee talk on his interesting experiences in hunting and fishing.

J. H. Redhead, president, Lake City Malleable Co., Cleveland, gave the principal talk of the evening on "Merchandising Castings." Mr. Redhead opened his discussion by defining the past depression as a breakdown of salesmanship. He maintained that at the present time too many men in the sales field lack a thorough training either in the business they represent or in salesmanship itself. According to the speaker, there is little difference between buying a casting and buying a hat, and the salesman must of necessity analyze the problem from the buyer's position. He pointed out that one difficulty with merchandising castings is the lack of aggressiveness in the foundry field and stressed the need of pushing itself forward. The foundry industry through its products, castings, is making a valuable contribution toward the comfort and well being of the civilized world, and that fact should be broadcast.

Mr. Redhead stated that in his opinion too many salesmen lose sight of the fact that castings have dramatic values as well as practical, and cited simple methods of demonstrating physical properties as opposed to the standard, scientific practice. While not exact, such procedure has attracted considerable attention, due to the dramatic appeal. In closing, the speaker said that the castings salesman must be the best informed man available. He must know materials, buying, manufacturing, and values. The importance of castings in the industrial and everyday life is such that it offers a challenge which must be met and overcome by aggressive action of the industry.

Smith Facing & Supply Co., 1857 Carter road, Cleveland, has been appointed distributor for the Knefler-Bates Co., Indianapolis, in north central Ohio and northeastern Pennsylvania. Charles S. Tanner Co., 244 South Water street, Providence, R. I., will handle the sale of the core binder produced by the Knefler-Bates Co. in New England.

CORE SAND RECLAMATION

• Recently installed, this Bartlett-Snow core sand reclaiming system is typical of others. Cores are first broken in a revolving screen. The sand is then fed by belt over a magnetic pulley that removes small metallic pieces, and carried by bucket elevator to an overhead storage bin located directly over the mill.

Power requirement for a system of this type is small . . . it requires a minimum of floor space . . . permits the re-use of 50% of old sand in making new cores.

Full details, including estimates of a reclamation system adapted to your requirements, available on your request.

Write for complete description.

THE C. O. BARTLETT & SNOW CO.
6201 Harvard Avenue, Cleveland, Ohio
In Chicago, First National Bank Bldg.
In New York, 30 Church Street

BARTLETT SNOW FOUNDRY EQUIPMENT

SHAKEOUTS • SCREENS • ELEVATORS • CONVEYORS • HOPPERS • MIXERS • AIR FILTERS
PARTIAL AND COMPLETE SAND PREPARATION AND SAND DISTRIBUTING SYSTEMS

General view of the operating foundry where the method of casting the valve push rod was demonstrated

Ford Glorifies the Iron Foundry

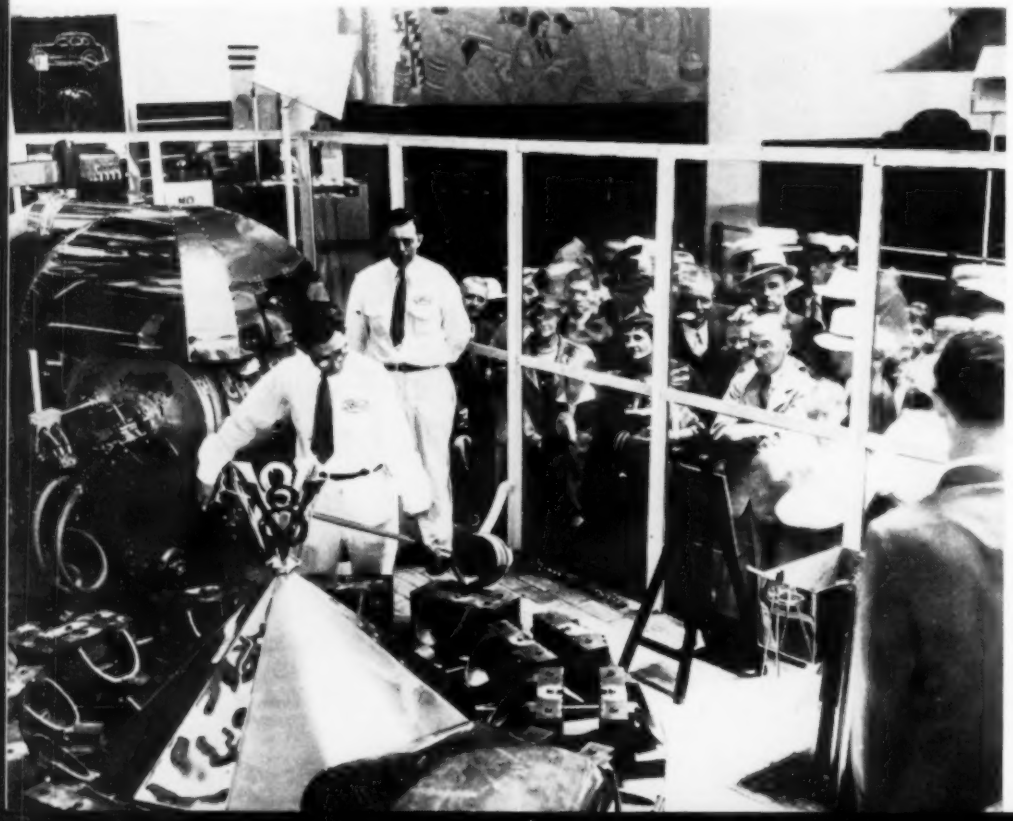
VISITORS to the California Pacific International Exposition at San Diego during the summer of 1935 were interested greatly in the Ford exhibit. The main building comprising three industrial halls portrayed various processes in the fabrication of an automobile, scientific exhibits bearing upon inspection and testing and the wide range of products produced by the Ford Co. Attendance at the Ford exhibit in California totaled more than two million persons. George E. Clark, who had charge of the technical foundry exhibition at Chicago, directed a similar exhibit which was featured this year in California.

Strikingly presented against a background "The iron foundry — the most precious metal — the foundation of manufacturing" melting and pouring operations were carried on.

The foundry exhibit was similar to that in Chicago in that an electric furnace and a complete permanent mold unit making valve tappets was operated before the visitors with a lecturer explaining various steps in the process.

The California exhibit differed from that in Chicago in that a different type of electric furnace was used in melting. That in California while frequently employed for melting iron has been widely used for nonferrous melting. Accordingly, it was decided to melt a low temperature lead alloy to demonstrate the process of manufacture of a part which normally is gray iron. Heats were taken off every half hour and the Ford engineering staff explained the character of castings production operations.

The main central portion of the group of buildings portrayed key processes in the manufacture of Ford automobiles and trucks. Flanking the circular sides of this central portion were dioramas, six on each side showing how the principal raw materials, iron, aluminum, zinc and lead, copper, sillimanite, cotton, wool, soy beans, asbestos and cork are produced to build the modern car.



Pouring metal into permanent molds at the Ford display at the San Diego Fair

Chicago Chapter Stages Record Outing

A record crowd of 327 attended the stag outing held by the Chicago chapter, American Foundrymen's association, at the Lincolnshire Country club, Sept. 21. The day's program consisted of golf, baseball and horseshoes, followed by a dinner and entertainment in the evening. The attendance was drawn from the Chicago and adjoining districts, with American Manganese Steel Co. leading the registration with 76 members and guests.

About one-half of the number present participated in a golf tournament, some 40 prizes donated by various companies identified with the foundry industry. First prize was won by George Birkenstein, S. Birkenstein & Sons Inc., Chicago, for his low gross score of 78. Among the other leading prize winners were: A. J. Klein, F. Fones, R. Eckesell, M. J. Gregory, L. C. Thunfors, J. Munroe, R. F. Wright, A. Gierach and D. S. Kennelley.

T. J. Magnusen, J. S. McCormick Co., was general chairman of the committee in charge of the affair. A. F. Burtt, American Manganese Steel Co., was secretary of the committee, while H. A. Strain, Carnegie-Illinois Steel Corp. was head of the golf tournament. Other members of the committee included W. C. Packard, National Engineering Co. and secretary of the Chicago chapter; Oscar Olson, S. Obermayer Co.; Charles Kawin, Chas. C. Kawin Co.; E. Longenbach, American Manganese Steel Co.; J. H. Owen, Harbison-Walker Refractories Co.; D. N. Gellert, Nichol Strait Foundry Co.; W. Hitchins, Pyle National Co.; J. Thomson and M. G. Sternberg, Continental Roll & Steel Foundry Co.; D. E. Clifford and J. H. Abbott, Hickman Williams & Co.; and N. F. Hindle, American Foundrymen's association.

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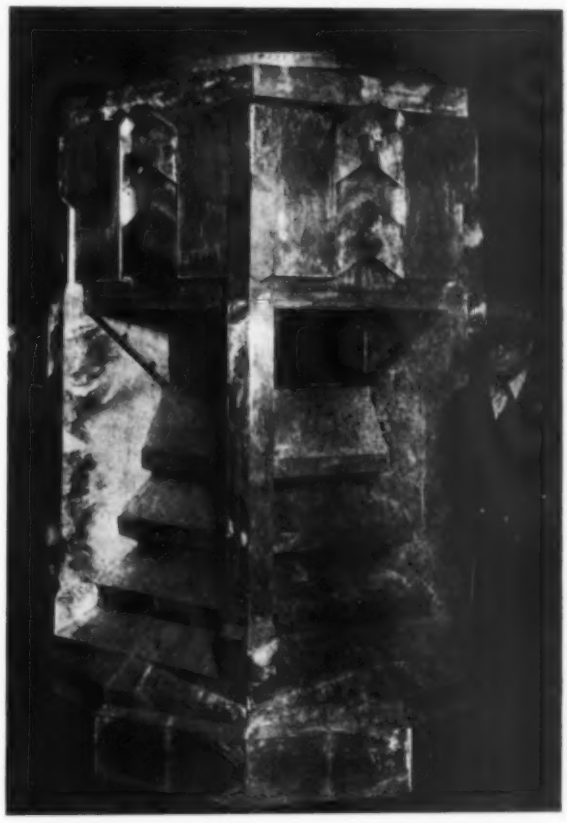
Makes Large Lantern For Boulder Dam Of Aluminum Castings



Sixty-eight castings with a total weight of 1500 pounds were used in each of the four lanterns

PACIFIC BRASS FOUNDRY of San Francisco, recently completed a contract for four large aluminum lanterns for the intake towers of the Boulder Dam. A number of interesting features of design and construction are incorporated in these lanterns.

The castings are made from an aluminum-silicon alloy, similar to S.A.E. No. 35 or the Aluminum Co. of America No. 43. Since the castings were subjected to stringent chemical analysis under government inspection, it was necessary to use only new metals in the mixture.

Besides serving as beacons, these lanterns also are used as ventilators. Ribs or flanges 3-inches wide were cast on the edges and back of each casting. Because of the hexagonal design of the lantern, these flanges were toed in toward the center line, which made a v-shaped pocket on the back and which naturally made a somewhat intricate casting instead of what would otherwise have been an easy molding job.

An item of particular interest in the production of the castings is the construction of the flasks used in making the base section of the lanterns. The ends of the flasks were made to conform exactly to the irregular parting line of that particular piece, with the result that one side of both drag and cope was about 8-inches higher or lower than the opposite side.

Each lantern, as erected, is 10 feet 6 inches high, and is constructed from 68 separate castings made from 12 different patterns. All castings were molded in green sand and the molds were skin dried. The dome casting, weighing 157 pounds, is the heaviest of the group.

The base plate is 12-sided, measuring 7 feet 6 inches across. The body formed of the ventilator sections is of hexagonal design with a diameter across the flats of 6 feet 5 inches. The thickness of the sections in different members varies from ⅜ to ½-inch, according to the specific location and purpose of the structure. The total weight of metal for the lanterns was 6000 pounds or 1500 pounds for each of the four units.

With the exception of the base members and the dome at the top, most of the castings are flat sections with flanges cast along the sides for bolting to adjoining sections. All of the louver castings for the body of the lanterns are made with a tapered edge to fit into the column faces of the flanges, thus permitting fitting with the file.

The lanterns, when set in place on Boulder Dam, will be supplied with six flood-light type lamps having a rated capacity of 300 watts per lamp.

Book Review

Gmelin's Handbook of Inorganic Chemistry Gmelin's Handbuch der Anorganischen Chemie), Part A-Sections 4 and 5, paper, 260 and 320 pages respectively, published by Verlag Chemie G.m.b.H., Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, and in Europe by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, London.

These volumes published in German are a continuation of the series of Gmelin's handbook relating to iron, and Section 4 discusses indirect processes for winning of wrought iron and steel. The processes described include the refining hearth method and the puddling process. Manufacture or production of soft iron and steel by the crucible, converter, open-hearth, reverberatory, and electric furnace processes with detailed information on bath reactions, operating methods, etc., not to forget extensive references and abstracts from available literature.

Section 5 relates to general physico-chemical principles of methods of production of wrought iron as a theoretical supplement to the previous section whose content is essentially technical in nature; iron and steel founding, ferroalloys and other addition materials, and supplementary data on production of commercial iron which brings the information up to August, 1933. The portion on iron and steel founding occupies 78 pages and contains a wealth of information on the various methods employed, and numerous references to literature on the subject.

To Handle Flux Sales

American Solder & Flux Co., Wayne avenue and Berkley street, Philadelphia, has been appointed representative by the Maluminum Co., Indianapolis, for the sale of foundry fluxes in Delaware, Maryland, western New Jersey and eastern Pennsylvania.

Appointed Sales Agent

Charles A. Strelinger Co., Detroit, has been appointed agent of the General Refractories Co., Philadelphia, for the Detroit territory.

Putting Caesar on the spot

The Adventures of Bill

BY PAT DWYER

UNDER the head of *Good and Welfare of the Order* one night recently, Bill rather startled me by the announcement that he did not think he would attend any further conventions of the American Foundrymens association. Clearly something out of the ordinary must be responsible for such a momentous decision. In the past he has looked forward to one of these events with the keenest and most joyful anticipation. He has a riotous and soul satisfying reunion with all his old cronies and he has kept his long ears sharply cocked at the various technical sessions. In fact on more than one occasion I have heard him maintain stoutly that attendance at these conventions is mandatory if a foundryman is to keep up with the procession.

"If you are not bound by a vow of secrecy," I said, "and if it is not connected in any way with the development, exploitation and distribution of your famous Emergency Valve, perhaps you would be kind enough to throw a hint or two in this direction as to how and why you arrived at this revolutionary decision."

"Well," said Bill, "Ill tell you. The atmosphere is becoming too high brow. So long as the discussions are in English, I generally can get the drift of the thing, even when some of the words are over my head. Believe it or not, some of these words are as long as a $\frac{3}{4}$-inch lifter. In fairly large type a half dozen of these bouncers would equal the length of an old time stove plater's wooden rammer. However, as I say, so long as the words are English and therefore presumably to be found in the dictionary, I am a willing, although not an enthusiastic listener. When the speakers go a step farther and set up an argument in Latin I'm through. I'm done. I quit and I don't care who knows it."

"Latin?" I echoed in amazement. "You must have been wandering round in a dazed condition and finally landed in St. Michael's seminary instead of the Royal York hotel. I circulated around the hotel rather extensively and heard nothing but English in its three main divisions, formal, colloquial and —er — ah — shop English. Foundrymen do not use Latin."

"That's what you think. That's what I thought too until I discovered this particular nest. Mind you I do not claim that all the discussions were in Latin, but I found two lads up to their ears in it and the contagion is bound to spread.

"Proceeding along the corridor toward my room one evening—what time? I don't know. What's the difference? Let's say night time and let it go at that—my attention was attracted by an open door and the sounds of loud wassail. Clearly this was the time and place for all good men and true to rally to the support of the party. Several enthusiastic seekers for the truth were reclining at ease, while a jovial gentleman standing on the center of the floor was delivering a lecture on core oil.

"Supplementing the oral presentation an assistant presided over a table whereon reposed a large tray containing several glasses, half a dozen bottles of a colorless liquid and a dish of cracked ice. Holding aloft a bottle of the amber color core oil in one hand the lecturer claimed that it was made according to a secret formula developed first by Aaron, the first foundryman of record and used with great success in the casting of the Golden Calf. The secret was closely guarded by the members of Aaron's family, but a Chinese laundryman one day found the formula in the pocket of a shirt and immediately departed for his native land. Students of foundry history are familiar with the many magnificent and intricate bronzes turned out in China during the Ming and succeeding dynasties. The answer? Core oil!

"Picking up little odds and ends here and there, Marco Polo on a tour of one of the Chinese foundries pinched a flask of the precious fluid from a core-bench and brought it back to Italy where it was snapped up by that all around snapper the late Signor Cellini. With it he was enabled to attain a reputation that endures to this day. Readers of Cellini's biography will recall that although he presents full and detailed accounts of his flights and his amours,

(*Continued on page* 54)

Committee on core oil conducts exhaustive series of tests

JOLT-ROLL OVER-SQUEEZE
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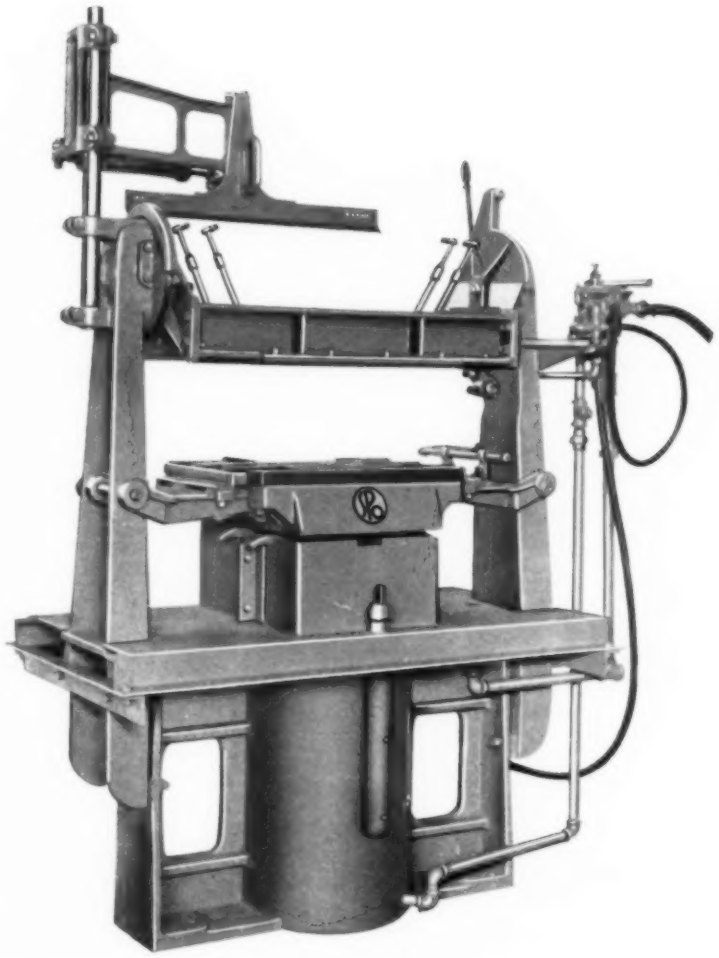

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Your equipment dollars go further and come back quicker with SPO molding machines.

(*Continued from page 52*)

and some of his methods in producing statuary, he carefully omits any reference to the core oil. Foxy lad, Ben.

"The speaker regretted that he was not in a position to divulge the circumstances under which the formula recently had been acquired by his company. Familiar as they all were with threatened international complications over the oil situation in Abby—er, ah — Abbas — that is to say Ethiopia—he was sure his hearers would appreciate the delicacy of the situation and not press him for further details. Loud cheers from the audience. Also 'encore' 'Oil's well that ends well,' Oil, Oil, the gang's oil here,' 'Oil the brothers were valiant!" and 'Oils quiet along the Potomac.'

"Bowing in graceful acknowledgment to this unanimous and courteous tribute and appreciation, the lecturer launched into a technical description of the new core oil in its preparation, application and effects. Observe the color, gentlemen, a blend of molten gold, living fire of the topaz, the full harvest moon and rippling sunlight on a field of ripened wheat. He used these poetical comparisons advisedly. Gold as a standard of worth and integrity, topaz for strength and virility, the moon as a symbol of purity, and the wheat to emphasize the purely vegetable scurce of the product. Add 'em all together and what have you got? One of the listeners skeptically said he did not know the answer, but off hand, and just for the sake of the argument if nothing else, he'd say banana oil. He hastily begged to withdraw this palpably erroneous opinion when the lecturer coldly stated that if there was one thing he hated more than another it was a dog in the saddle, or two snakes in the bush."

"You'll pardon me, dear lad," I interrupted Bill at this point, "but what has become of the Latin argument? I do not claim any intimate familiarity with the language, but I think I should recognize one or two old friends. Are you still on the main track, or have you lost your way again?"

"What do you mean, again? Keep your shirt on and *cave canem* which according to a somewhat free translation means keep your eye on the ball—"

"When I was a boy *cave canem* meant beware of the dog."

"When you were a boy! Har, har. Lot of things have changed since you were a boy. Where are the dogs of yester year? Up the flue, over the river, hopped the twig, gone, vanished like your old friend Villain's last year's snow and the dames with all the fancy names. Beatrix, Berthe, Alys, Herembourges who held Le Mayne. Just like the words of a song. High stepping babies, every one of 'em—"

"Whether they were high steppers, pigeon toed or bandy legged, so far as I can see at the moment, is not a factor in the present discussion. If a suggestion is in order, and the chair thinks a suggestion most decidedly is in order, might I remind you that up to the present either through accident, natural dumbness

Daniel outside the lion's den

or design, you have avoided any reference to the cause, the subject matter, or the result of the Latin argument."

"Sweet Mother in heaven," Bill spread his hands and rolled his eyes upward, "grant me patience. I started to tell you the story in proper order and sequence and would have finished it long ago if you had sense enough to emulate the other members of your family, the invertebrate. These intelligent little creatures are inarticulate.

"Le's see, where did I leave off?"

Complete and dignified silence on the part of the party of the second part.

"Ha! So you won't speak, eh? Good. Now we'll begin to make some progress. Following an appreciative reference to the color of the core oil, the speaker in turn dwelt at some length on various characteristics and physical properties and drew attention in particular to the fact that it was shipped in glass containers. Two main reasons were responsible for this procedure. One was a desire for a fitting climax to the methods of production carried on from beginning to end under the most sanitary conditions and under rigid laboratory control. The second was the fact that up to the present glass was the only material immune to the action of the oil.

"This point was confirmed by a gentleman lying on the bed who stated that purely in the interest of science he had swallowed a gill or maybe a gill and a half of the undiluted stuff and immediately afterward felt as if he had swallowed a mule's red hot shoe with the mule still attached and in excellent kicking fettle. Only under the most extreme provocation would he be induced to repeat the experiment. Later he was induced to modify his extreme stand in this respect and admit that in the sacred name of friendship he might be persuaded to try the experiment on Sundays and legal holidays, the beginning, middle and end of the week, on Saturday night and other special or extraordinary occasions.

"With true showman instinct, a natural gift developed to a high plane of excellence through varied experience, the lecturer sensed the temper of his audience and felt the time was ripe for a practical demonstration.

" 'This bottle of core oil,' he said, 'which I now hold aloft in my right hand, cursed tax and import duty duly paid, possesses many rare, curious and valuable properties. In my humble way and with all due modesty I have touched upon a few of these features. Now I shall acquaint you with the most remarkable feature of all, a feature which definitely sets this core oil apart from all other core oils on the market. A feature which entitles it to a special niche in the hall of fame and a ringing salute from the bugles (Aside. Hey, one o' you guys better ring up the bell captain and get some more ice). This marvelous feature to which I refer, gentlemen is known as absent treatment. To make cores with this binder you need no sand, no coreboxes, no plates, no ovens. You are clear of the dust, the grime, the smoke and the sweat, the head and back aches.

" 'Here,' says he, suiting the action to the word, 'I simply place about two fingers of this magic elixir in each glass, you add the ice and a sufficient amount of the thinner to fill the glass, apply the glass to the lips in this manner, tilt the elbow through an arc of approximately 30 degrees, close your eyes and let 'er flicker down the hatch! Presto! Your core troubles are over. You can sit here in comfort and make more cores in a hour than the man in the shop, using ordinary core oil could make in a week. Every core perfect, no sticking to the box, no swelling or sagging in the oven, no blows, drops, cuts or scabs. The vent comes off as freely and sweetly as the breath of an infant on its mother's breast, and finally the burned core runs out of the casting as slick as the sand in a hour glass, or a dose of goose grease through a tin horn.' "

"He paused here," Bill said, "and skillfully appraised the remainder of the contents in the bottle. 'Just about enough for three more hookers. Here's where I emulate that sterling

(*Concluded on page 76*)

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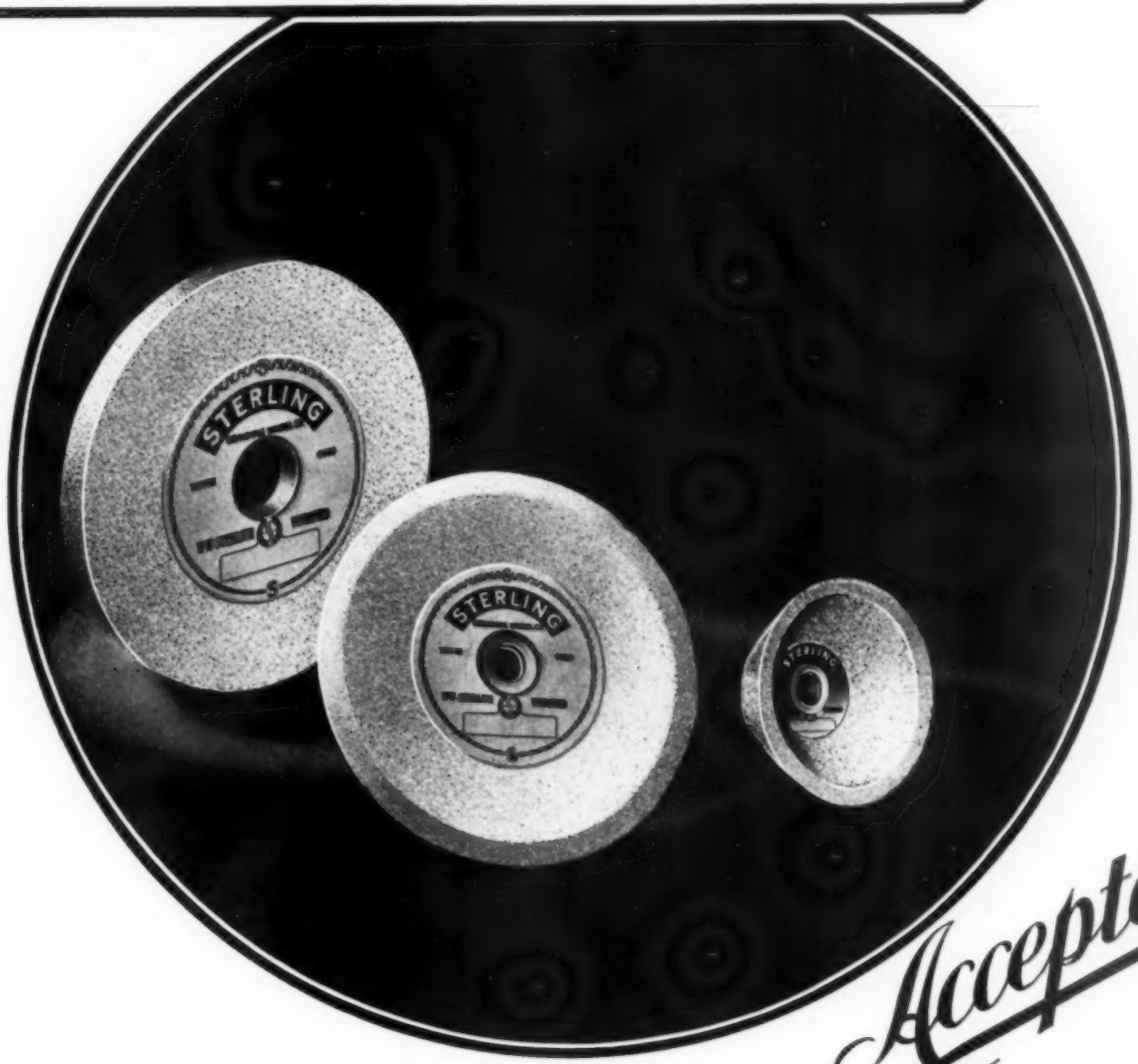

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STERLING ABRASIVES

Many Castings Used on Bridge

(*Continued from page 23*)

To a certain extent a bridge of any kind is a symbol of man's supremacy over existing conditions or the forces of nature. Confronted by an unsurpassable barrier to his freedom of movement, or the movement of his goods and chattels, he constructs a bridge and travels blithely on his way.

From a technical standpoint, a brief reference to existing records would seem to indicate that the construction of a bridge, as an engineering structure, although quite elemental in its engineering features may be traced back more or less accurately to the Chinese. As with many other subjects in the fields of industry, science and commerce, the Chinese appear to have been the first people to employ the masonry arch for the purpose of continuing roadways across streams.

Reveals Character of People

However, the art of bridge building as developed in the various countries was not evolved from the early Chinese practice. Independent effort characterizes its development in each country. As stated previously, from the very nature of the structures built in the past, the present day investigator is enabled to formulate very clear and accurate ideas as to the character, customs and importance of the people who built them.

Bridges in which true round arches were employed to connect the piers were built in Italy in the sixth and seventh centuries B. C. Roman bridge building methods were carried through stages of greater and greater perfection until the fourth century B. C., when the Roman policy of building great military roads to bind their possessions together permitted the highest development of their engineering skill in structures of this kind. The brilliant and unrivaled careers of bridge and viaduct construction thus inaugurated by the building of the famous Via Appia and culminating in the erection of the eight great bridges of Rome, has furnished models for all succeeding centuries and are applicable today in the construction of stone structures. Some of the bridges of the Republican period still remain. The Ponte Lupo (bridge of the wolf) and the viaduct of the Anto Vetus aqueduct was built about 143 B. C. The viaduct near Gaboo, built about 122 B. C., consisting of seven arches about 292 feet long still is in use.

The Sublician bridge built by Ancus Martius across the Tiber between the Janiculum and the Aventine mountain was famous for its defense by Horatius Cocles against the great army of Lars Porsena. The only one of the urban bridges of Rome that remains intact is the Fabrician bridge, Ponte Fabricio, built in 62 B. C. The greater part of the most magnificent of them all, the Aelian bridge, Ponte Sant' Angelo, built by Hadrian in 136 A. D., also remains.

With the expansion of the empire many bridges were built upon the fine macadamized roads which connected with various outlying provinces. The work was done by the Roman legions under the direction of their skillful military engineers. The greatest structure was the bridge across the Danube, built in 103 A. D., by the engineer Apollodorus to enable the emperor Trajan to conquer Dacia. Massive stone piers were connected by a superstructure of wood with a total length of 4770 feet. In the succeeding centuries stone bridges were built at many places in all European countries.

At the close of the eighteenth and the beginning of the nineteenth centuries, metal began to be extensively introduced as a material of construction. Although the masonry arch was superior in beauty and durability, the metal bridge gave greater strength in proportion to the weight of the structure, was capable of being built more quickly and cheaply and therefore being better adapted to keep pace with the tremendous activity of modern railroad construction, it soon almost completely supplanted the stone structure. In recent years concrete has been employed almost universally for foundations, piers, abutments and in many instances for the entire structure.

The first structure in which metal was used appears to be the bridge across the Severn near the town of Ironbridge, Shropshire, England. It was built by Abraham Darby, the owner of the iron works of Coalbrookdale in 1779 and consists of a single arch 100 feet in span with a rise of 45 feet. The arch is composed of five cast iron ribs which form the segment of a circle. Several other metal bridges of bolder design were built during the last quarter of the eighteenth century. The Wearmouth bridge over the Wear at Sunderland is the most elegant example of the type. As originally constructed it consisted of a single arch 236 feet in span with a rise of 34 feet above the springing lines 95 feet above the level of the river.

Cast Iron Is Employed

In the period between 1860 and 1870 the Westminster and Blackfriars bridges, both of cast iron were built across the Thames in London with spans of 185 feet. The Alexander III bridge built across the Seine in Paris in 1899 has a single arch 362½ feet. The arch ribs of wedge shape are cast steel sections bolted together.

One of the first, if not actually the first—and at that time the longest—suspension bridges in the world was built at Wheeling, W. Va., by Charles Ellet in 1848 with a span of 1010 feet. The Niagara railroad suspension bridge with a clear span of 821 feet was built by John Roebling in 1855. The Cincinnati and Covington bridge over the Ohio with a clear span of 1057 feet was built in 1867. The last and greatest suspension

(*Concluded on page 59*)

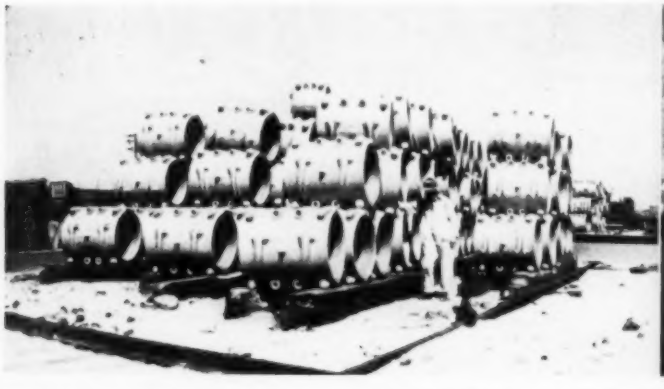

Fig. 13—Suspender cable bands, each weighing from 1000 to 1600 pounds. Fig. 14—Close view of suspender cable bands

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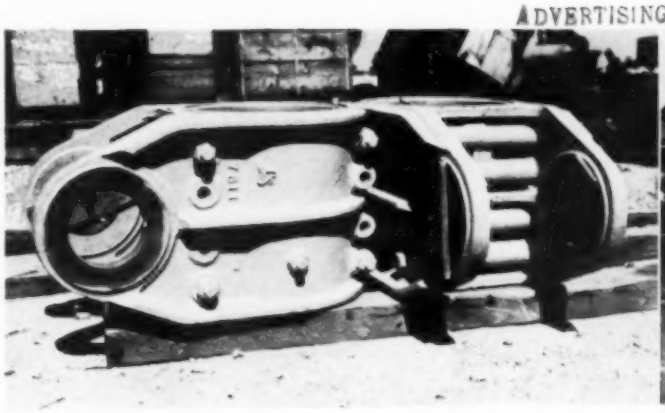

Fig. 15—Suspender cable bands at rocker post connection. Fig. 16—Five cast bronze bells for East and West Bay crossings. Two large bells weigh 3000 pounds

bridge built by John Roebling was the Brooklyn bridge across the East river, connecting Manhattan island to Long Island. This bridge built in 1883 has a main span of 1595½ feet, two shore spans of 930 feet each. The Williamsburg bridge further up the East river was completed in 1904, with a clear span of 1600 feet. Towers are steel instead of masonry as in the Brooklyn bridge.

Many notable steel bridges have been built in the United States and elsewhere during the past 25 years. Readers readily will call to mind the Quebec bridge over the St. Lawrence, the Delaware river bridge connecting Philadelphia and Camden, N. J., and the George Washington bridge with a span of 3200 feet, longest of any bridge in existence, over the Hudson river and connecting upper Manhattan with New Jersey.

Builds Largest Bridge

For the past two years work has been in progress on the greatest bridge ever attempted, a double deck structure for interurban, railroad and vehicular traffic between San Francisco and Oakland, California, on the opposite side of the bay. Total length of the bridge is approximately 5½ miles, 2 miles from San Francisco to Yerbe Buena island and 3½ miles from the island to Oakland. Including many other features new records have been established for depth of piers. One of the caissons is sunk to a depth of 235 feet. It is claimed that the steel and concrete incorporated in the structure is equivalent to the amount used in building all the large office buildings in San Francisco. The bridge was designed and is being built by the department of public works of the state of California under the general supervision of C. H. Purcell, chief engineer.

Contract for the entire superstructure including cables is in the hands of Columbia Steel Co., subsidiary of the United States Steel Corp., with fabrication and erection by the American Bridge Co., another subsidiary of the corporation. Other units of the corporation contributing products include Carnegie Steel Co., Illinois Steel Co., American Steel and Wire Co., National Tube Co., Lorain Steel Co., and Tennessee Coal, Iron and Railroad Co.

From San Francisco to Yerba Buena island is a distance of 2 miles, too great for a single suspension. A concrete center anchorage was built in the center of this space and a suspension bridge built on either side. The anchorage, 197 feet in length by 92 feet wide, rises 502 feet from rock on the floor of the bay to a height of 280 feet above the water line. Two towers, one on either side of the anchorage rise to a height of 700 feet above the base on the floor of the bay, or in effect to the height of a sixty story building.

A double deck tunnel 58 feet high, 76 feet wide and 540 feet in length, the largest bore tunnel in the world, has been constructed through Yerba Buena island. On the bridge six lanes for automobiles are provided on the upper deck with three lanes for trucks and two lanes for interurban cars on the lower deck.

The East Bay section of the bridge from the island to the Oakland shore is of the cantilever type with spans of 1400 feet. The first cantilever anchor on the island contains 11,000 cubic yards of concrete. On the suspension section of the bridge the two cables are 28¾ inches in diameter, contain 69,000 miles of wire, weigh 18,700 tons and are designed to support a dead load of 80,000 tons plus a live load of 35,000 tons. The steel in the superstructure of the bridge weighs 170,000 tons.

Weight of structural steel, reinforcing steel and cables is over 200,000 tons and represents 6.7 per cent of the entire United States steel production in 1933. In addition the bridge carries over 2000 tons of steel castings, 200 tons of iron castings and 50 tons of phosphor bronze castings.

Bronze navigation bells and other miscellaneous castings were made by the Enterprise Foundry Co., San Francisco. The large steel saddle castings were made by the General Steel Castings Corp., Eddystone, Pa., and machined by the Federal Ship Co., Kearney, N. J. The splay castings were made and machined at the plant of the Lorain Steel Co., Johnstown, Pa. Cable bands were cast by the same company and machined jointly at the Ambridge and Pencoid plants of the American Bridge Co. A large number of steel castings were cast and machined by the Bethlehem Steel Co., Bethlehem, Pa.

Appoints Agents In Mid-Western Cities

Royer Foundry & Machine Co., Kingston, Pa., manufacturer of sand preparation and other foundry equipment, has appointed A. T. Wagner Co., 2700 Wight street, Detroit, and M. W. Warren Coke Co., 115 Miller street, St. Louis as representatives in the two territories designated.

A. E. Smith, 320 Jackson building, Buffalo, has been appointed representative of the company in the Buffalo territory.

N. F. A. To Meet

Annual meeting of the National Founders association will be held in the Waldorf-Astoria hotel, New York, Nov. 20 and 21. Thomas W. Pangborn, Pangborn Corp., Hagerstown, Md., is president and J. M. Taylor, Chicago, is secretary of the association.

Club in New Rooms

Machinery Club of Chicago recently was reorganized and now is located in newly furnished club rooms at the southeast corner of Jefferson street and Washington boulevard in the heart of the machinery district of Chicago. Clyde W. Blakeslee, sales manager, N. A. Strand Co., Chicago, is president of the Club.

Increases Strength with Alloys

(*Concluded from page 25*)

the center to form the dovetail joint for the die block, or for the second section of the block, if the anvil is to be constructed in two or more parts. In some instances a long shallow channel is scraped in the sand bed to form a seat for a dry sand core. The pattern for the anvil block, a plain box structure then is lowered into position on the prepared bed. The upper face is flush with the floor level in the immediate vicinity.

One or more sections of dry sand cores with a suitable gate opening in the center are placed in position at one or both ends of the pattern, depending on whether the casting is to be poured at one end or at both ends. A gate stick is erected at the outer end of the gate core, a 2-inch thickness of facing sand is banked against the pattern to a height of about 6 inches. Floor sand to the same depth then is shoveled around the pattern and rammed with pneumatic rammers. A miscellaneous assortment of rods from ½-inch to 1-inch diameter and from 10 to 14 inches in length are rapped into place on top of the sand for reinforcement. These rods with the inner ends about 1-inch from the pattern are spaced from 3 to 4 inches apart. Additional courses of sand are rammed and reinforced in a similar manner up to the top edge of the pattern.

Cores Form Trunnions

At four points previously marked on opposite sides of the pattern, hollow dry sand cores are placed in position to form trunnions for lifting the casting out of the mold and later handling, machining, shipping and setting up in the forge. A plain iron cope with suitable openings between the bars for the risers, is rammed on top, lifted off, finished, blacked and placed in the oven to dry. The part of the mold in the floor is covered with thin plates and dried with charcoal, coke fires or gas jets. A natural heavy loam sand is used for facing and is further strengthened by the addition of a dry core binder. The face of the mold is dried to a depth of 4 to 6 inches. The surface is covered with a high grade refractory blacking.

The steam hammer cylinder shown in Fig. 1 is cast in the position shown in the illustration. The pattern is split through the center and the mold is made horizontally in an iron flask. After the mold is dried and cored the two parts of the flask are clamped firmly and the entire flask is turned up on end. A long runner is formed in the joint face of the mold and the metal from this runner enters the mold through the flange shown at the left. One gate is close to the bottom, a second gate admits the metal about half way up and the third gate allows the last metal to enter the casting at a point near the top. The casting is fed through two large risers on the top flange.

One half the main core and the remainder of the entire set of cores for this casting are shown in Fig. 2. The main core is placed in the drag

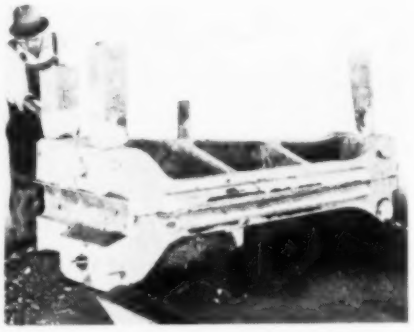

Fig. 6—Large feeding risers are required on castings made from the special alloy iron

of the mold where it rests on a small print at one end and a large print at the opposite end. After the core has been adjusted in place, two hook bolts are attached to steel loops in the large end. The outer ends of the bolts extend through a stiff steel bar resting on opposite sides of a large circular opening in the end of the flask. Nuts are screwed on these bolts and as a result, when the mold is turned up on end the core is suspended from the top, instead of resting on the comparatively small body of sand in the lower print. Suitable blocking between the upper bar and the top of the core, prevent the core from rising when the mold is filled with metal.

A quantity of coke in the main core reduces the drying time and also assists later in the free escape of the gas. The sand mixture substantially is the same as that employed for facing the mold. The smaller cores are made from various combinations of new sharp and bank sand. Facing and core sand are prepared in a muller type mixer made by the National Engineering Co., Chicago.

The port core shown on top of the main core at the left and the long, narrow core shown on top of the collection in Fig. 2 are surrounded almost entirely by metal of fairly heavy section and therefore require special treatment first to prevent distortion, second that the vent may escape freely, and third to facilitate removal from the casting. As a result of many experiments all three conditions are met satisfactorily by the following core sand mixture: 25 shovels coarse sharp sand, 5 shovels new molding sand, 18 shovels cleaning floor sand, 6 shovels old molding sand, 10 shovels burned core sand, 2 shovels fire clay, 25 pounds rosin. The sand is measured by the shovelful for convenience and on a weight basis to compare with the rosin it is accurate since a shovelful of dried sand weighs 11 pounds. The actual ratio on a weight basis is 1 pound rosin to 25 pounds sand.

Drag part of the mold for a hammer frame is shown in Fig. 4 and one of the castings is shown in Fig. 6. The metal is poured through a sprue which extends to the bottom on the side opposite the slides which must machine absolutely clean and solid. The casting is fed through a single large riser at the small end and through two larger risers on the higher and thicker end.

Reports European Industries Are Gaining

Verne E. Minich, president, American Foundry Equipment Co., Mishawaka, Ind., recently returned from Europe, and reports that the metalworking industries in a number of countries are recovering briskly. His appraisal is as follows:

Great Britain is in excellent condition. Prosperity, equivalent to our 1929 period is sweeping the British Isles. Many of the foundries and metal-working establishments are having difficulty in handling their production although operating to full capacity. Satisfying a need for modern production methods will assist materially in clearing that difficulty.

German business seems to be in a happy condition in face of financial difficulties with companies outside of Germany. The government seems to be active in building up its defense, and therefore the metal industries are quite active and internally are doing well.

Holland does not have much in the line of metalworking industries but its being on a fiat gold standard helps it as an importing nation.

Europe's acceptance of American business methods, including equipment for foundries is aiding materially in reducing costs.

New Side Frame Cast from Alloyed Steel

A truck side frame for 40-ton freight cars, developed by the Gould Coupler Co., Depew, N. Y., as cast from high strength nickel manganese steel, was shown at the recent National Metal congress and exposition in Chicago by the International Nickel Co. Inc., New York. It is claimed that by the use of that material, the weight has been reduced to 468 pounds per frame as compared with 546 pounds for A.A.R. specification grade B carbon steel.

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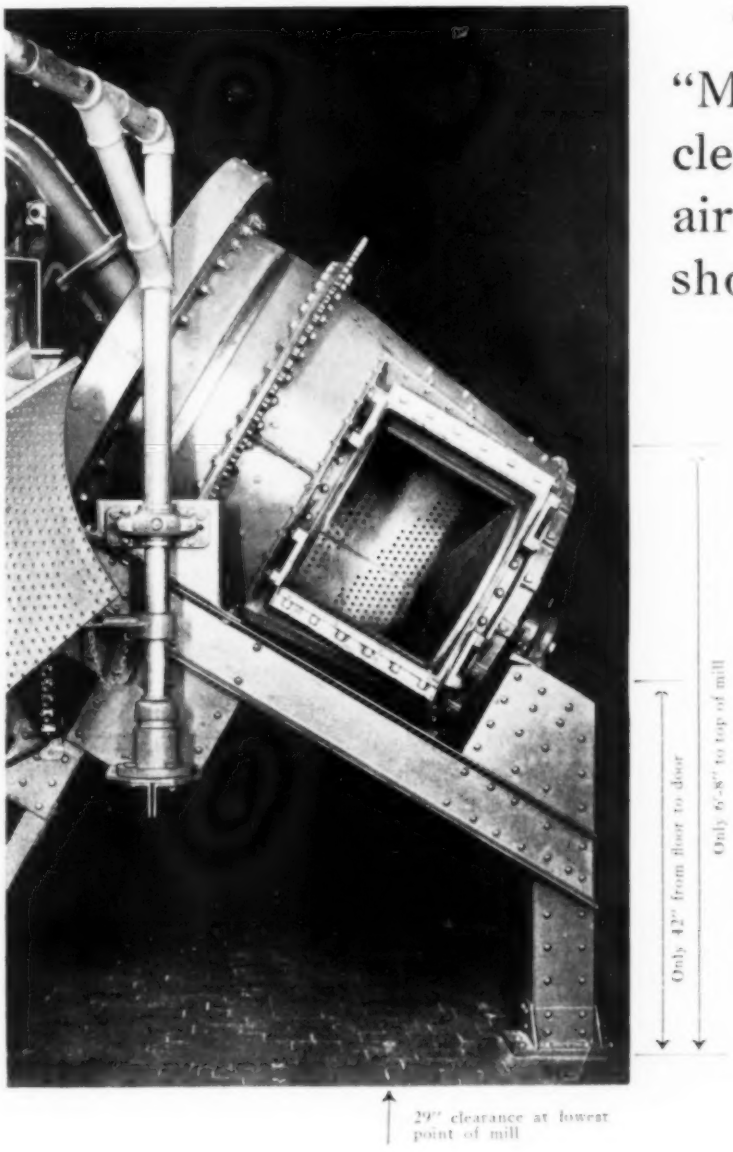

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Mark Half Century Anniversary

(*Concluded from page* 26)

about 10 pounds of metal; each melt took about 5 hours, and he had to make a number of melts to have a sufficient quantity of metal. He cast small ingots which he himself broke up into six pieces of approximately equal size and these were mixed to obtain greater uniformtiy. The equipment and requisites at his disposal were scant, and he had to supply most of them himself. He received a grant of 20 pounds from the Chemical society, and various grants of 10 pounds from the British association. He had to account for these grants and justify how the money was employed for his metallurgical researches.

Shows Softening Effect

Through his friendship with Prof. A. B. W. Kennedy, a then prominent civil engineer, he was able to have tests carried out on the testing machine at the University of London, from which he obtained the values shown in his tensile curve. For hardness tests he adopted the principles of a mineralogist's sclerometer, and obtained the loan of a writing diamond, which he fixed to a long wooden lath; he placed a weight at various points along the lath to vary the pressure of the diamond on the test-piece. He was thus able by the depth of scratch to show the softening effect of silicon on cast iron.

Among his first test-bars was one which gave a tensile strength of 15.7 tons, or 35,168 pounds which was then a record for any iron made in England.

About 1905 he devised and made a form of dilatometer, which enabled him to plot expansion and contraction curves during the solidifications and subsequent cooling of cast-iron. This simple instrument has since been adopted in many foundries, particularly on the continent of Europe.

Professor Turner pursued his metallurgical studies at the Royal School of Mines, under Sir William Roberts Austen. He was the first professor of metallurgy at the University of Birmingham, from 1902 to 1926. In the year 1925, a manufacturer who had benefitted by Professor Turner's work provided the University with funds to establish a gold medal to commemorate Professor Turner's paper of 1885 on the influence of silicon on cast-iron. On the face of the medal is a bust of Professor Turner, around which are inscribed the words "Silicon in Cast-Iron": On the reverse side is reproduced the tensile strength curve which was published in the original paper, and the words "His Researches Laid the Foundation of Scientific Ironfounding" are inscribed. A replica of this medal in gray iron, shown on page 26 was given to THE FOUNDRY.

The first recipient of this medal was Sir Robert A. Hadfield.

Professor Turner was the recipient of the Bessemer Medal of the Iron and Steel institute, 1925; the Joseph S. Seaman Gold Medal of the A.F.A., 1926; and the Oliver Stubbs Medal of the I.B.F., 1927. When the International Foundry Congress was held in London in 1929 a special gold medal was awarded to Professor Turner, and handed to him by the Lord Mayor to commemorate a presentation that had been made to him on his retirement after 25 years as professor of metallurgy at the University of Birmingham.

He was the first foreign honorary member of the American Foundrymen's association, having been elected in 1901. He is an original member and past-president of the Institute of Metals, vice-president of the Iron and Steel institute, original member and member of the council of the British Cast Iron Research association, member of the council of the Nonferrous Metals Research association, and member of the Imperial Institute Council for Minerals. He is also an honorary member of the Association des Ingenieurs Sortis de l'Ecole de Liege.

Writes Many Papers

Professor Turner has published over 100 scientific papers, dealing mainly with the metallurgy of cast-iron and other metals. His activities extend beyond the study of cast-iron, and in recent years he has directed his attention to the study of white metals (printing metals, bearing metals) and to die-casting.

During his years of activity he has widely traveled on the Continent of Europe, in the United States, Canada and Australia; and he values more than anything else the many friendships he has established.

Looking ahead with the same vision he evidenced in 1885, Professor Turner firmly believes today that gray iron will continue to hold its own against competing materials, and that, as the result of investigations carried out under modern conditions by individual workers or sponsored by scientific organizations, further progress will be made in mechanical properties, soundness, and the diversity of application of gray iron. He follows with interest the investigations now being made in the effects of inoculation and in the addition of various elements to cast-iron.

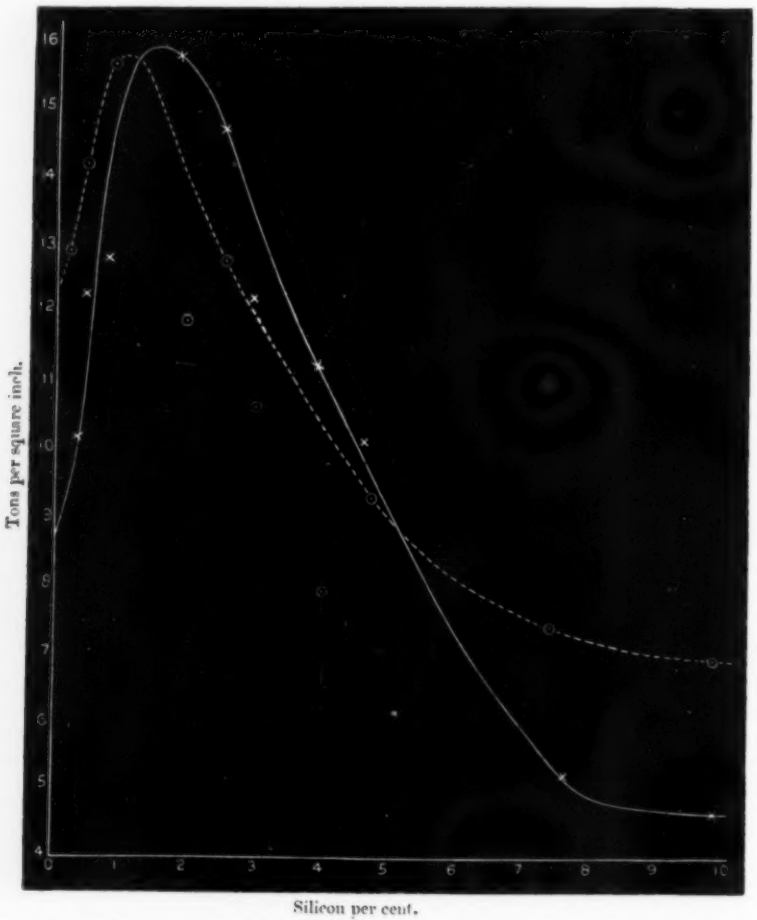

Diagram showing relationship of silicon to tensile strength and modulus of elasticity, solid and dotted line respectively. This is reproduced from the original in the Journal of the Chemical Society in Aug., 1885

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Equipment Purchases Increase

(*Concluded from page 27*)

the years 1922-23-24 as equaling 100 per cent. The low point in the industry index was reached in September, 1932, when the figures stood at 11.9 per cent, while 1933 showed some little increase, and 1934 also indicated gains. The year 1935, particularly from April to the present date shows a splendid gain, with promises of continuance. Figures for March, 1935, stood at 69.3 per cent. Since that month the index has shown a steady climb, August indicating 113 per cent; in fact every month since March with the exception of July was over 100 per cent. Indications are that the trend will continue. The accompanying charts are based on a moving three months' average, which presents a more definite indication of the trend. Close similarity between the trend in the foundry equipment field and the machine tool industry is striking.

More Equipment Needed

There are a number of reasons why foundries require increased equipment. It is recognized that there is a shortage of skilled men in the foundry industry as has been stressed by THE FOUNDRY. During the past years practically no apprentices were developed. Advancing age, employment changes, and normal mortality have taken their toll. As a result, anything approaching normal activity in the foundry industry today would find a serious shortage of men.

Another important reason for the increased use of equipment is the necessity for reducing costs. Inter-industry competition is severe and price is a factor.

Mr. Tuscany has pointed out that there was a growing hesitancy on the part of investors to provide funds for industrial expansion, that legislation causes capital to be extra cautious, and that the willingness to venture new undertakings was fast disappearing.

These conditions are being corrected. Financial agencies are encouraging equipment purchases. One indication is the change in regulations of the Federal Housing Administration act, made effective a few months ago. These new regulations extend F.H.A. insurance protection features, to loans for equipment purchases. Also of particular significance is the recent change permitting an increase from $2000 to $50,000 in loans for equipment purchases for a single property.

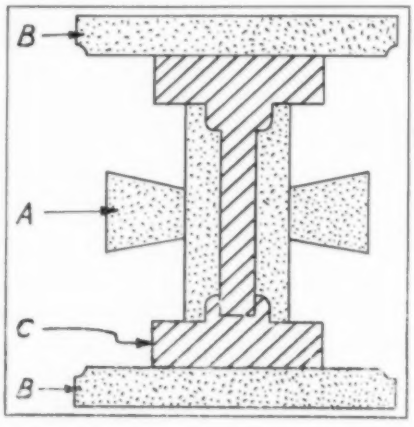
Another important factor in higher costs which must be reflected in equipment sales prices, is the social security legislation enacted by the last session of congress. This will mean taxes on pay rolls of approximately 10 per cent. This increase will be reflected in higher material costs as well as increased labor costs for each equipment producer.

Dry Sand Cores Reduce Molding Cost

By F. Marchant

On an order for two lathe beds 10 feet 6 inches in length, 20 inches in width, 8 inches in height and weighing approximately 1000 pounds, the first was molded in the usual manner and consumed the time for three men for 6½ hours, or a total time of 19½ molder hours. This time was cut down on the second mold to 3¾ hours for two men by casing the pattern in dry sand slab cores as shown in the accompanying illustration. A plain wood frame 1-inch thick and 5½ x 42-inches inside was nailed to a flat board. This was the slab corebox. Fillets taken from the pattern were tacked in the corners. A total of 30 of these cores were made, placed in the oven and dried. Miscellaneous pieces of short cores were pasted on the back of 12 of these slabs designed for place in a vertical position along the inside and outside walls of the pattern as shown. The short cores *A* served to anchor the slabs and hold them in place after the pattern was removed. No anchorage was needed on the covering cores *B B* on the top and bottom flanges.

The lathe bed pattern was placed on the roll over board as in the first instance. Slab cores were placed against the inside and outside walls. Then the drag was filled with sand and rammed to the top of the loose flange *C*. This flange was drawn out of the sand and the space was covered by the slab cores *B*. The remainder of the drag then was filled with sand, rammed, bottom board adjusted and the drag was rolled over. The cope was not rammed at this stage. The pattern was removed from the drag and the top of the mold was covered with slab cores. Then the cope was placed in position and clamped to the drag. Wedges were placed between the cope bars and the slab cores. The cope then was filled with sand and rammed. Sprues and runners made up in the usual manner. Started at 7 a.m., the job was ready to cast at 10:45 a.m.



Top, bottom and sides of the pattern were covered with dry sand cores

A few dry sand cores also greatly simplified the molding of an old fashioned grate bar 7 feet in length, 7½ inches deep and 3 inches wide. The pattern was badly battered. With the pattern for a corebox, four cores were made in the center section of the pattern. These were dried and then filed a little to fit easily in the slots of the pattern. Sand was rammed to a depth of about 3 inches in a drag and the pattern with cores in place was bedded down until the top showed about ½-inch above the joint level of the drag. The remainder of the drag then was filled with sand and rammed. The pattern was removed and the opening covered with slab cores. In lieu of blocks, cast iron clamps were placed flat on the drag so that the bars in the cope would clear the slab cores. The cope then was placed in position and clamped to the drag. The remaining procedure was the same as that employed with the lathe bed mold.

Measures Expansion, Contraction of Metals

Schenectady works laboratory of the General Electric Co., Schenectady, N. Y., is using a dilatometer, an instrument which measures and records in ten-thousandths of an inch the expansion and contraction of metals as they are heated and cooled. The device was built from specifications of the United States bureau of standards. The dilatometer consists of a small cylindrical furnace surrounding a quartz tube, the quartz tube withstanding high temperatures and having a minimum of expansion when heated. A round core of about the size of a thick pencil and made of the metal to be tested is placed within the tube, which is then electrically heated up to 1800 degrees Fahr. On top of the specimen is placed another smaller quartz tube, sealed at both ends, to transmit the dilation of the specimen to a dial gage. The gage is connected by an invar clamp to the outside quartz tube and can be read to 0.0001-inch.

Fourth International Heating and Ventilating exposition will be held at the new International Ampitheatre, Chicago, Jan. 27-31, 1936. The National Warm Air Heating and Air Conditioning association will meet in Chicago during that week.

ADVERTISING PAGES REMOVED

Studies Green and Dry Strengths

(*Continued from page* 28)

as some of the high clay sands increased and some decreased green strength with increase of moisture.

It is well known that mulling of tempered sand and clay mixtures produces a more intimate and uniform contact relation (greater contact area) of bonding particles with sand grains and that increase of temper water of the mix increases, with given pressure, the flowability not only of the mix but facilitates interparticle movement.

Therefore, it seems that two factors — moisture and pressure — are responsible for the accumulation of these strength contacts; and that it is in their increase and the modification of their water skins that the strength change has been made in the mulled sand compared with its unmulled duplicate.

This change in strengths, as appears from the average values of all the tensile and compression tests, is shown in the Table on page 28.

Predicated on the assumption that the area of contact of bonding particles with sand grains is identical for the development of green and of dry strengths, why, with increase of moisture, did green strength decrease and dry strength increase in all the individual mulled tests?

Factors Producing Strengths

Before attempting to answer the question, one should know, if possible, what the factors are that produce these strengths. The report of the A.F.A. committee on molding sand research — *Transactions*, A.F.A., volume 39, pages 564 and 565 — defines them as follows:

GREEN STRENGTH — Green Bond Strength. The resistance which a molded specimen of sand while tempered, offers to an applied stress before it breaks.

DRY STRENGTH—Dry Bond Strength. The maximum resistance which a molded specimen of sand, dried at 105 to 110 degrees Cent. (221 to 230 degrees Fahr.) offers to an applied stress before it breaks.

It may be that these strengths can be understood by the ounces or pounds per square inch which measure them but certainly these values do not explain the factors which produce them.

C. A. Hansen in his paper "The Physical Properties of Foundry Sands" — *Transactions* — A.F.A. — vol. 32, part II, pages 57 to 97 — frankly puts the question "What is Green Strength." Based on experimental work, he gives an opinion that it is almost purely a matter of the surface tension of the water held between the grains of a compacted sand. That surface tension forces are adequate to account for the observed character of green strength. (It is fair to assume that in the use of the word *grains* Mr. Hansen had in mind all the individual particles of both sand and clay.)

Dr. P. G. H. Boswell, on pages 75 and 76 of his booklet *British and American Foundry Practice*, states: "All successful natural bonds of molding sands appear to belong to that class of bodies known as colloids . . . The essential point about colloids and one bearing on their presence in molding sands is their exhibition of surface phenomena; their special properties are therefore dependent upon surface energy . . . Clays have been found to contain variable quantities of colloids . . . The bond of molding sands when moist would thus appear to be due to the surface tension of water skins held by the films of clay substance and hydrated iron oxide coating the sand grains."

The late A. A. Grubb in a paper written in 1930, described the increase of surface area from reduction of a 1-inch cube into ever smaller cubes as follows:

If a cube of this size, having an area of 6 square inches is cut into cubes 0.5 x 0.5 x 0.5-inch, the total surface area is increased to 12 square inches. If cut into cubes 0.25 x 0.25 x 0.25-inch the total surface area is increased to 24-inches. If the 1-inch cube could be reduced to cubes of colloidal dimensions, say 0.00001 x 0.00001 x 0.00001-inch, the total surface area would be increased to 600,000 square inches. (This increase of total surface area would be relatively true no matter what shape or form the particles assumed from their continued division.) Mr. Grubb further stated, that to understand the bonding effect of water, we must understand the phenomena of surface tension and capillarity. The surface of a liquid is always under tension and acts like an elastic film trying to occupy the least possible area. Surface tension of liquids is a definite measurable force.

In the report of the committee on sand grading—*Transactions* — A.F.A., volume 35, page 191 — it is stated that "To classify clays with respect to the quality of clay, it is necessary to classify clays with respect to particle size."

In the report of the subcommittee on grading of foundry sands—*Transactions* — A.F.A., volume 36, page 74 —it is stated that "It is fairly well established that the bonding strength of a clay, particularly its dry bonding strength, is closely related to the fineness of subdivision of its particles".

It is submitted throughout these statements and conclusions that there plainly appears the conception of strength emanating from fineness of particles as related to surface area —surface energy.

The purpose of this discussion is to account for the development of the strengths, green and dry, of the sands tested using the theory of surface area — surface energy (strength) and without recourse to or dependence upon conditions of stickiness, as generally understood, of the bonding particles involved.

Added water is a primary requisite for the development of the green strength of any dry sand-clay mix but no part of this water may be present in the mix at the time it develops its full dry strength. If strength contact area is one and the same thing for the development of the green and of the dry strength of duplicate samples of a given sand, then the resultant dry strength value, in ounces or pounds per square inch may be taken as a measure of this area.

Dry Compression Higher

As shown in the accompanying table, by the average values of the mulled tests, compared with 6 per cent moisture, green compression at 8 per cent moisture was 16 per cent lower and at 10 per cent moisture was 29 per cent lower; dry compression at 8 per cent moisture was 59 per cent higher and at 10 per cent moisture was 121 per cent higher; green tensile at 8 per cent moisture was 16 per cent lower and at 10 per cent moisture was 28 per cent lower; dry tensile at 8 per cent moisture was 55 per cent higher and at 10 per cent moisture was 120 per cent higher.

It results that at 8 per cent, compared with 6 per cent moisture, the strength contact areas of both the green and dry compression tests increased 59 per cent and at 10 per cent moisture they increased 121 per cent. Similar comparisons may be made of changes at the different moistures, of the common strength contact area of the green and dry tensile tests.

In connection with this 59 per cent increase of area, green compression strength decreased 16 per cent and dry compression increased 59 per cent; while with the 121 per cent increase of area green compression strength decreased 29 per cent and dry compression increased 121 per cent.

It does not seem reasonable to attribute to increase of contact area of bonding particles with sand grains, a weakening influence in the development of green strength and a strengthening influence in the development of dry strength. It is necessary to assume that it is a strengthening influence in both cases, but

modified in the case of the development of green strength by the weakening influence of the increased water present. The 16 per cent decrease of green compression strength appears to have resulted from the effect of 59 per cent increase of strength contact area and 33 1/3 per cent of water; the 29 per cent decrease of green compression strength to have resulted from the effect of 121 per cent increase of area and 66 2/3 per cent of water. The full effect, unmodified by the weakening influence of water, of these increased strength contact areas was reflected in the respective increased dry strength value, as no water was finally present in the baked specimens.

Tests Moisture Influence

As the mulled tests, without exception, resulted in decreased green and increased dry strength substantially in proportion to increase of water, it seems reasonable to conclude with reference to these tests,

(1) That dry strength resulted in proportion to the number of baked contacts and that these contacts were accumulated in proportion to wetness of mix and pressure applied.

(2) That green strength resulted in proportion to the number of contacts at their particular thickness of water skins. That these contacts were accumulated in proportion to wetness of mix and pressure applied.

(3) That the higher the moisture, at given pressure, the greater the number of contacts which was a plus influence for the development of both dry and green strength but all the contacts carried thicker water skins which was a minus influence in the development of green strength.

(4) That the increased contact area at higher moisture was a less powerful influence for increasing green strength than the consequent thicker water skins were for decreasing green strength.

These conclusions apparently explain why, with increase of water in the mulled tests, green strength decreased and dry strength increased.

It is difficult to attempt an explanation, consistent with test results, of the influence of water and pressure on the development of the green strengths of the unmulled sands when compared with the mulled sands or with each other.

It is apparent that the pressure factor operating in the unmulled tests was lower than in the mulled tests. In the unmulled tests, it was the pressure resulting from three impacts of the rammer head. In the mulled tests it was that 4 minute mulling plus three impacts of the rammer head. The comparative sample moistures being the same, evidently the lower pressure with resultant lesser area of contacts, bearing thicker water skins, explains the substantially lower green strengths, while this lower pressure with the same smaller area of contacts explains the lower dry strengths of the unmulled compared with the mulled tests.

It seems reasonable to suppose that with equal pressures (three impacts of the rammer head) applied to sands in the condition of the unmulled and mulled samples that strength contacts were accumulated at higher ratio in the unmulled samples for the reason that they held more potential contacts for accumulation, a substantial portion of the original, potential contacts having been previously effected in the mulled samples by the mulling.

If this is true then there resulted a variance in the ratios of contact accumulation of the unmulled compared with the mulled samples while the sample water increase ratio remained the same for both.

As evidence of the higher ratio of contact increase of the unmulled compared with the mulled samples, reference is made to the average dry tensile and compression values of all the sands tested, as follows:

Unmulled: Dry tensile from 6 to 10 per cent moisture increased from 33.9 to 149.2 ounces or 340 per cent.

Mulled: Dry tensile from 6 to 10 per cent moisture increased from 129.4 to 284.6 ounces or 120 per cent.

Unmulled: Dry compression from 6 to 10 per cent moisture increased from 20 to 85 pounds or 325 per cent.

Mulled: Dry compression from 6 to 10 per cent moisture increased from 66 to 146 pounds or 121 per cent.

It will be noted the ratio of increase of strength contact area was much higher in the unmulled than in the mulled samples.

While the strength contact area of the mulled samples was greater than in their unmulled duplicates, as reflected by their substantially higher dry strengths, we are concerned here with the effect of given increase of water on sands developing relatively a small number of strength contacts as in the unmulled tests, compared with their mulled duplicates, developing a larger number of contacts.

Increase The Strength

At given pressure and increase of water, the unmulled sands which increased green strength must have done so because strength contacts were accumulated at sufficiently higher ratio, compared with increase of water ratio, to not only off-set the weakening influence of the higher water content but to bring about a sufficiently thinner water skin per strength contact to account for the increase of strength.

In the case of those unmulled sands which showed little change of green strength with increase of water, the weakening influence of increased water content seems to have been counteracted by the strengthening influence of the increase of the strength contact area.

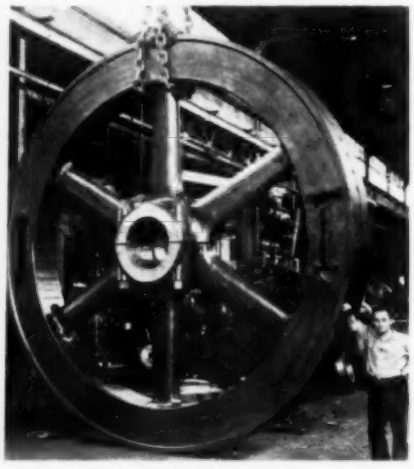
In the case of those unmulled sands showing a decrease of green strength with increase of water, strength contact area was not able to develop sufficiently to counteract the weakening influence of the increase of water and the water skins per strength contact must have thickened.

The variance of strength contact accumulation ratio compared to water increase ratio seems to explain the nonuniform green strength results of the unmulled samples, not only as compared with the mulled samples but with each other.

At 8 per cent moisture the contacts developed in the *unmulled individual sand* seem to have carried thinner water skins, been not much changed or have borne thicker skins than the contacts developed in the same sand tempered at 6 per cent moisture, depending on the ratio of increase of strength contact area in comparison with the ratio of increase of water, and likewise at 10

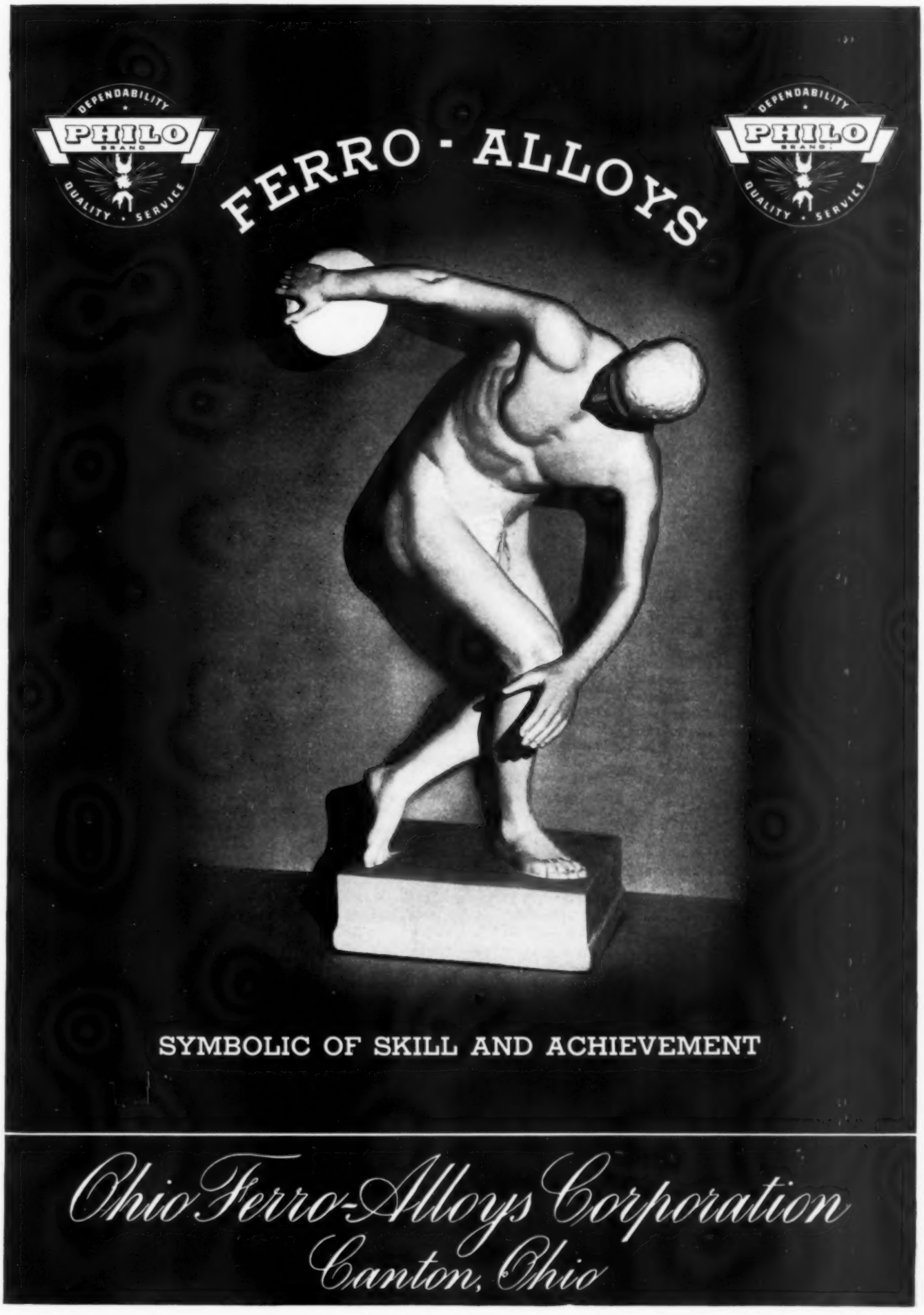
(*Concluded on page* 70)

Casts Large Fly Wheel



ONE of the largest gas engines ever to be located in West Virginia recently has been installed in the power plant of the Owens-Illinois Glass Co., Kanawha City, W. Va.

The new gas engine, produced by the Cooper-Bessemer Corp., Grove City, Pa., is rated at 1350 *horsepower. The huge flywheel for this engine, which is shown in the accompanying illustration, weighs* 60,000 *pounds and is* 14 *feet in diameter. The flywheel was cast in Grove City, Pa., foundry of Cooper-Bessemer Corp. of which D. M. Whyte is foundry superintendent. The new engine itself weighs* 400,000 *pounds.*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SYMBOLIC OF SKILL AND ACHIEVEMENT
Ohio Ferro-Alloys Corporation
Canton, Ohio

(*Concluded from page* 68)

per cent compared with 8 per cent moisture.

At 8 per cent moisture the contacts developed in the *mulled individual sand* seem to have uniformly carried thicker water skins than the strength contacts developed by the same sand tempered at 6 per cent moisture and likewise at 10 per cent moisture compared with 8 per cent. For, notwithstanding the increase of contact area with increase of moisture the green strength uniformly decreased. Evidently with the mulled samples the ratio of contact area increase more nearly paralleled the ratio of increase of water.

It appears from all the individual unmulled and mulled tests that dry strength resulted in proportion to strength contact area; that potential development of this area was not disclosed by any one test at fixed moisture and pressure. Rather this development was disclosed by varying the water content or pressure or both so as to permit the interparticle movement of the mix of which it was capable. It also appears that those factors which resulted in green strength jointly operated so as to hinder, in proportion to the amount of green strength developed, interparticle movement of the mix.

Therefore, from a strength viewpoint, it may be that the potential strength contact area capacity of a molding sand is of more significance than its green strength, that the degree to which a heap sand develops green strength in excess of that required to make and maintain the mold until it is being poured, it limits to that extent the development of dry strength.

Contact Area Rearranged

The degree of spread or growth of strength contact area of a sand, capable of performing given work, as evidenced by its strength values at different moistures and pressures comes, perhaps, somewhat close to measuring its useful dry strength life. For it is not what green strength the sand in a given mold tests at its particular moisture and density that defines its continued serviceability. Contingent upon its production of the given satisfactory casting, it seems more a question as to what degree the shakeout sand can develop into reality from further conditioning and molding, potential strength contact area to offset loss of dry strength from the accumulation in the sand of partially or wholly burnt out (dehydrated) bonding particles, no longer able to function.

This strength contact area is probably largely rearranged between each drying out, retempering and compression of the sand.

"The life of a molding sand can be burnt out of it without greatly affecting its green strength on retempering: but the burnt sand develops no dry strength", C. A. Hansen, Page 95, Part II, volume 32.—A.F.A.—*Transactions.*

Seventy-five or 80 heat tests of naturally bonded molding sands, using an apparatus devised by the L. H. Marshall Co., Columbus, O., have shown that a given heat lowered both green and dry strength, but the decrease of dry strength was on the average two to three times that of the green strength.

"Burnt out" in the practical sense is a relative term. Molding sand is burnt out in proportion as its individual bonding particles have become dehydrated. The present dry strength serviceability of a foundry heap seems to depend on the extent of dehydration of its bonding particles and the uniformity of dissemination of the affected particles throughout the mass of the sand so that too large aggregates of them may not arrive at or too near the face of the molds, where they fail as the pour is being made.

The sands, test results of which have been discussed in the main part of this article were unaffected by heat other than that used in the baked tests. The tests were made for the author by the L. H. Marshall Co., Columbus, O.

Handbook Gives Data on Alloy Steels

Bethlehem Steel Co., Bethlehem, Pa., recently has published an illustrated handbook, "Bethlehem Alloy Steels" devoted to special steels in the form of bars, billets, blooms and slabs. The purpose of the handbook is to give users of alloy steels dependable working data on properties and performances, to bring all pertinent existing data on these alloy steels up to date in one complete volume.

Production facilities of the company and quality control methods are covered in two brief chapters which precede six main divisions, namely, grades of steel, steels for specific uses, testing and properties of steel, working of steel, definitions of common terms, and tables and useful information.

One of the distinctive features is the color charts of heat colors and temper colors. The handbook may be secured from the Bethlehem Co. for $1.00.

Opens Detroit Office

American Monorail Co., 13107 Athens avenue, Cleveland, has opened a sales and engineering office at 7338 Woodward avenue, Detroit. C. L. Fell is in charge of the Detroit office.

Quad City Chapter Holds Initial Meeting

First meeting of the recently organized Quad-City chapter of the American Foundrymen's association was held at the Blackhawk hotel, Davenport, Iowa, Sept. 16, with 90 present. A. E. Hageboeck, Frank Foundries Corp., Moline, and president of the chapter, presided. Alex Matheson, chairman of the fellowship committee, introduced 12 out of town visitors.

Vaughan Reid, City Pattern Works, Detroit, and president of the Detroit Foundrymen's association, spoke of the proposed affiliation of the Detroit group with the A. F. A. He extended an invitation for all members of the Quad-City chapter to attend the convention of the American Foundrymen's association to be held in Detroit in May, 1936.

R. E. Kennedy, technical secretary, American Foundrymen's association, spoke on the co-operative effort of chapter activities and discussed the possibilities for greater service under the new organization. John Ploehn, French & Hecht, Inc., Davenport, reported on the apprenticeship session at the recent Toronto convention. Mr. Ploehn spoke of the pressing need for good mechanics and asked that all give serious consideration to that phase of the work. Hy Bornstein, Deere Co., Moline, reported on several of the technical sessions.

M. J. Gregory, plant manager, Caterpillar Tractor Co., Peoria, Ill., in the feature address of the evening, spoke of the many problems that confront the foundry executive in building up an organization. One of the first mentioned was the securing of properly trained men, which means the training of mechanics to operate the business. Mr. Gregory also emphasized the need for a comprehensive interview as a means of securing better placement for men.

Other problems mentioned included the handling of equipment, the securing of qualified men for important jobs, dust control, maintenance repairs, materials, and safety and personnel work. The speaker also discussed a number of manufacturing problems, citing examples of difficult castings. Proper plant management, he pointed out, includes co-operation between the several departments involved in the making of the casting.

The next meeting of the association will be held at the Fort Armstrong hotel, Rock Island, Ill., Oct. 21. Harry W. Dietert, Detroit, will speak on "Molding Sand Control".

Steel Sales Corp., Chicago, distributors for steel and numerous nonferrous metals, has opened a sales office and warehouse at 4067 Park avenue, St. Louis.

Stoney Core Grinder

These machines have proven themselves to be a very big factor in cutting down costs.

In one case the operator did four times the work previously done by hand filing and it was found that the number of cores ground would have required $3.00 worth of files daily.

One grinding wheel costing $12.00 lasted fifty working days.

The Stoney

Foundry Engineering & Equipment Co.

5321 St. Clair Avenue Cleveland, Ohio

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE — *Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Training Foundrymen

TO THE EDITORS:

Being fortunate enough to attend the meeting of the Quad-City chapter of the A.F.A. on Sept. 16 in Davenport, Iowa, I was particularly struck by one subject of Mr. Gregory's interesting talk. To me it was a new angle on the apprenticeship situation and one that should appeal to young men seeking an opportunity, and who thus far have passed up the foundry as a means to success.

Instead of using the expression *apprentice molders*, Mr. Gregory used *training young men to be foundrymen*, which expresses much greater possibilities. Mr. Gregory, who is factory manager, foundry division, Caterpillar Tractor Co., Peoria, Ill., is himself a product of the fine apprentice system of Brown & Sharpe, Providence, R. I. Being one of the foremost foundrymen in the country he should be an example to aspiring apprentices.

In his talk, Mr. Gregory explained that in their own foundry there is no limit to how far an apprentice can go, and just as soon as one shows ability he is pushed ahead.

We are going to need these trained foundrymen in the years to come and it seems to me that talks such as Mr. Gregory made should in some way be put into the hands of young men, who are not acquainted with the possibilities for success in the foundry business.

SALESMAN

Not A Mankiller

TO THE EDITORS:

I have read your editorial in the September issue of THE FOUNDRY and was interested in your comments on the subject of industrial health. The line "Foundry work is not a mankiller" struck me quite forcibly, for I cannot forget the eloquent testimony given a few years ago by the local organization for fighting tuberculosis as a result of examination of every employe of our shop.

You may be interested in the statement or report as given by the organization at that time, as follows:

There were four divisions or gradings, *A* being perfect, *B* in good health but showing a slight trace or possibility of trouble, *C* showing a condition serious to warrant attention and *D* showing a most serious situation.

Group *A* had 5 per cent of employes
Group *B* had 88 per cent of employes
Group *C* had 7 per cent of employes
Group *D* had none.

I thought the report showed a surprising amount of good health and controverted a current idea that foundry work was a mankiller or unhealthful. I do not give the above as evidence that our shop was so much better than any other, but rather as a bit of testimony for the trade or occupation in general.

The report was made for the Barlow Foundry, when they occupied their shop on R.R. avenue and before our merger in 1929.

ARTHUR E. BARLOW

Sacks-Barlow Foundries, Inc.
Newark, N. J.

Dry Polishing Cast Metal Specimens

(*Concluded from page* 33)

the metal. Only properly preserved inclusions can be identified by microscopic methods.

The following set of micrographs show how the procedure can be applied to gray irons, white cast irons, malleable irons, steels and nonferrous alloys. Fig. 16 shows a large graphite flake in a matrix of pearlite. Note that there seems to be a microstructure to the graphite. The micrograph was taken at 2000 diameters. Fig. 25 shows a pearlitic gray iron at 2000 diameters. Fig. 17 shows the microstructure of a high carbon, high silicon iron cast against a chill. The micrograph was taken at 100 diameters and shows massive carbide in a matrix of pearlite. Figs. 18 and 19 show a chill cast iron called Ni-Hard. This metal was cast in a permanent mold and shows massive carbide in a matrix of hardened martensite. The magnification is 800 and 2000 diameters respectively. Figs. 21 and 22 show black heart malleable iron at 100 and 800 diameters respectively. Fig. 20 shows the structure of the steel shell, the carburized bond and the gray iron portion of a centrifused iron. The magnification is 200 diameters. Fig. 23 shows a heat resisting austenitic steel cast in a permanent mold. The magnification is 100 diameters. Fig. 24 is a macrograph of an 80 per cent zinc, 20 per cent copper brass, taken at 12 diameters. This shows the polishing of nonferrous alloys.

The method used by the author is practical, simple, economical, and can be applied to any foundry metallurgical laboratory. The technique of polishing is not difficult considering its many applications. It is a process when carefully used will bring profits to the foundryman through improvement of metal structure by microscopic methods. It will help the foundry industry progress along the scientific line.

Made Sales Manager

Norman W. Yaeger, Essex Warehouse Co., 600 Ogden street, Newark, N. J., has been appointed eastern sales manager of the Certified Core Oil & Mfg. Co., Chicago. A complete stock of core oil will be carried at that address for immediate delivery.

Fig. 23—Micrograph of a pearlitic gray cast iron, x2000, etched

ADVERTISING PAGES REMOVED

Buyer Views Foundry Problems

(*Continued from page* 35)

is only the first item of equipment and materials desired for a quality casting. Five different grades of sand are obtained from as many proven sources of supply, bought in carload lots according to specifications adapted from the A. F. A. committee's work on grain size, permeability, clay content, and freedom from organic matter. Similar rigid specifications control purchases of sea coal, plumbago, core oil, and flour. Core or molding sand is mixed in ½-cubic yard batches in a small muller, according to one of ten regular formulas as required for a standardized job, or to special formula as set upon occasion by the superintendent.

Long ago the company learned that far more productive labor was lost by an insufficient supply of flasks, sand, gaggers, nails, or chaplets than could possibly be saved by lower investment in supplies. Consequently an ample supply of everything necessary for the job is readily available to coremaker and molder. This, together with an orderly layout, promotes the idea of cleanliness. For instance, even the cleaning room in the Sterling foundry is a model. It is a light, airy, well-ventilated room, with ample floor space around each operation, a concrete floor, well swept, windows washed and an atmosphere clear enough so that the painting department can put on the final touches in one side of the building, not even separated by a partition.

Take Pride in Appearance

All large machine tool castings are rough ground on surfaces that are not to be machined, given a ground coat of paint, smoothed with filler, and painted according to specification. This is done for two reasons. First it is better to paint a casting before it is soaked with oil in the machine shop, and second, the whole foundry takes pride in the sleek condition of the castings on the shipping platform. Lastly, everyone who handles these parts, clear up to the erection aisle, treats them with more respect.

Good foundry equipment extends to flasks. All flasks for floor work and jolt machines are of sturdy section. Only a few sizes are on hand, it being better to use some extra sand on an oversize flask than to stock and find exactly the right size. All flasks (drags, cheeks and copes) of a given size are surfaced top and bottom and pin-holes drilled from templet, to be completely interchangeable. Braces in all copes are removable, being wedged into niches cast in the inner wall.

Probably the ultimate quality in cast iron is achieved in a lathe bed. It may be a large casting, weighing up to 6000 pounds and varying considerably in thickness. It has close tolerance as to size, contour, and surface blemish. It must be free from hard spots, hard enough to wear excellently in the massive ways and yet be easily machinable in the thin sections around the gear box. The machined finish must be free of the slightest imperfections and the casting must contain no large internal stress. It must be stiff enough to maintain accurate alignment despite rough handling, uneven foundation, and age. Furthermore, it must be free of harmonic vibrations of periods within the operating spindle speeds.

Certainly all these requirements are difficult to insure in a casting of a single metal. However, these specifications have been met with a high test nickel iron, cast in what is in effect a core mold.

As in all good foundry practice, the greatest care and foresight have been expended in the design of the mold and cores, their proper support, reinforcement, venting and gating, to insure that metal can enter fully into all cavities with the minimum of scour, and at the correct temperature so it will solidify without the defect of sponginess if too hot, or gas cavities if too cool. Furthermore, traces of loose sand or dirt in the empty mold cannot be tolerated. Slag and dirt from the ladle and pouring basin are excluded by perforated sheets of "skimmer tin" covering the gate opening. Gates on all sizable castings are also made of hard baked cores to prevent scour. They are so shaped as to give the hot metal a swirling or centrifugal motion, thus holding particles of lighter slag and dirt at the center and top of an eddy, and the clean metal enters the mold cavity through a slot at the bottom of this feeding gate.

An up-to-date foundry today would classify its production about as follows:

Type of Iron	Range of Tensile Strength (Lbs. per sq. in.)
Common cast iron	Under 30,000
High grade cast iron	30,000 to 38,000
High test cast iron	38,000 to 50,000
High strength cast iron	Over 50,000

Warner and Swasey lathe beds are made of high test cast iron, as shown in the foregoing classification.

Since gray iron is fundamentally a steel structure or matrix broken up by graphite flakes, its strength is affected by (*a*) amount, size and distribution of the graphite flakes, and (*b*) strength of steel matrix—which depends in turn upon the amount of combined carbon and the alloying elements present. In order to be free of hard spots the combined carbon must be distributed throughout the steely matrix in pearlite, an intimate mixture with soft iron, and not as larger particles of the hard carbide.

In common gray iron the steely matrix, which has of itself a tensile strength on the order of 100,000 pounds per square inch, is badly broken up by relatively large flakes of graphite, occupying 5 to 10 per cent of the total volume. Production of higher strength cast iron involves the reduction of the total carbon, and therefore the *amount* of graphite, and the production of a very large number of very fine flakes. The lower total carbon is effected by replacing a large proportion of high carbon pig iron in the cupola charge with steel (in this case as much as 80 per cent of steel rail is on the charge). The fine granulation of the graphite flakes is had by melting the charge very hot, and by alloying with about 1.5 per cent nickel.

Close Control Necessary

It is obvious that when 20 parts of a selected pig iron is melted with 80 parts of steel rails containing about 0.80 per cent carbon, the mixture must absorb some carbon from the hot coke with which it is melted in order that the metal at the tap hole may contain about 2.80 per cent carbon. On the other hand, contact between molten metal and hot coke in the cupola must be short, else too much carbon must be absorbed. The desired result can only be achieved by close control of the entire operation—careful proportioning of materials, charged in the proper order, melted quickly and removed from the spout almost as soon as melted (that is, tap frequently and hold in large ladles under hot charcoal until cooled for pouring).

Former practice in melting iron for lathe beds used 50 per cent or less steel in the mixture, and the greatest care was taken to control silicon rather than the microstructure of the iron. Silicon had to be low else the casting would have a porous structure, yet not so low that graphitization was prevented. A prime function of the silicon is to cause excess carbon to form as graphite rather than as carbide; too low silicon would therefore be associated with hard spots where the iron solidified quickly on light sections and corners. Faced with this alternative and the necessity of maintaining machinability, the foundryman would run the silicon up and risk an open-grained casting. Present melting practice and the addition of nickel produces hardness up

to 269 Brinell and at the same time the castings are machinable.

Each lathe bed has a test block attached to it, and serial number and date cast on. Its dimension and placement in the mold are such that its structure represents that of the critical section in the completed casting. It is broken and the fracture studied, and one half sent to the Warner & Swasey plant. It forms a permanent record and material for any desirable special examination, although production has been so standardized that a brinell hardness test is not necessary.

When rigidity is a matter of importance, as it usually is in machine tool construction, the use of nickel also improves the stiffness of the iron. Tests by the International Nickel Co. show that Young's modulus of ordinary gray iron is usually between 12,000,000 and 15,000,000 pounds per square inch, whereas high test 1½ per cent nickel iron has a modulus between 18,000,000 and 24,000,000, this being much nearer steel at 30,000,000. Obviously metals with higher modulus deflect or stretch a lesser amount for a given load, and are a factor in maintaining the high accuracy given a machine tool by its maker.

The old proverb that "a chain is no stronger than its weakest link" holds good with respect to castings used in the manufacture of machine tools. Absolute accuracy in a machine tool is obtainable only when all of its component parts are accurate. A machine tool, such as a turret lathe, is essentially a precision instrument and therefore the same degree of attention and carefulness must be given to the making of the castings as is given later in the alignment of the spindle and to the grinding of the gears.

Castings Feature Machine Tool Show

(*Concluded from page* 29)

the wide majority of modern machines seen by over 40,000 buyers during the ten days the show was open.

Further, the industry should be proud of three of its member firms whose judgment of merchandising opportunities led to the maintenance of attractive exhibits at the National Machine Tool show. Displays of the Fulton Foundry & Machine Co., Lake City Malleable Co., and the Wellman Bronze & Aluminum Co., all of Cleveland, are illustrated at the beginning of this article. Not only did these artistic and well designed displays attract attention for the individual companies represented, but they carried to all exhibition visitors a story of the progress that is being made in three branches of the foundry industry, namely malleable, gray iron and nonferrous.

Valuable properties of cast metals were stressed by several machine tool manufacturers. At one booth, the stiffness of plain cast iron was compared with that of a high test nickel iron through a test in operation.

The Adventures Of Bill

(*Concluded from page* 54)

coremaker, patriot, statesman and champion divider the late lamented J. Caesar. I shall divide the remainder into three equal parts, even as he on a similar famous occasion divided Gaul into three parts *Omnis Gallia est divisa in tres partes.*'

"The gent reposing negligently on the bed snorted in derision. He was willing to admit that as a core oil purveyor and demonstrator the gentleman with the bottle was in a class by himself, but as a Latin scholar—well, not so hot. Every school boy knows that in Latin the verb comes at the end of the sentence, therefore the quotation should be *Omnis Gallia divisa in tres partes est.*

"To much for me," Bill concluded. "Latin may be all right in its place, but when I am sampling core oil, all I want is a little white rock or ginger ale in mine."

New Jersey Group Discusses Iron Founding

An address entitled "Up-to-Date Cupola Practice for Jobbing Foundries" was presented by R. H. Lee, field metallurgist, Bethlehem Steel Co., Bethlehem, Pa., at the first fall meeting of the New Jersey Foundrymen's association, Monday evening, Sept. 16, at the Downtown club, Newark, N. J. Mr. Lee's remarks covered cupola practice for ordinary mixtures, the production of castings of 40,000 to 45,000 pounds tensile strength, the control of carbon and a comparison of cupola practice in the middle west and the east.

The following directors were elected for the ensuing year: J. Robert Campbell, Campbell Foundry Co., Harrison, N. J.; J. W. Reid, Robins Conveying Belt Co., Passaic, N. J.; A. G. White, White Foundry Co., Jersey City; and J. A. Williamson, Isbell-Porter Co., Newark; and Alexander Spence.

Expect Graphite Rise

Apprehension is expressed by those familiar with the graphite market that interference with shipping, due to the Italian-Ethiopian troubles, may force high prices. Ceylon and other eastern sources provide graphite, widely used in foundry facings, mold wash for ingots and graphite crucibles.

Book Review

The Pneumonokonioses (*Silicosis*) *Literature and Laws of* 1934 (Book II), by George G. Davis, M. D., associate clinical professor of surgery, Rush Medical college, University of Chicago; Ella M. Salmonsen, medical reference librarian, John Crerar library, Chicago; Joseph L. Earlywine, attorney at law, Chicago. Fabrikoid, 490 pages, 6 x 9 inches, published by Chicago Medical Press, Chicago, and supplied by THE FOUNDRY, Cleveland, for $7.50 until Nov. 1, 1935, after which the regular price will be $10.00, plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

Book I of this series by which the literature and laws pertaining to dust existing in the United States and foreign lands are made known to the world was published previously and consists of an organized and indexed presentation from Agricola's "De re Metallica." in 1556 through December, 1933.

The second book which covers 1934 includes abstracts, extracts, and reviews which were not possible with the extensive coverage of literature and laws of the past. An author's index, subject index and bibliography of publications made available since the earlier work enable the reader to refer quickly to the particular phase of the dust problem which is of interest to him. Articles, papers, news items, opinions, scientific advance, medical developments, experimental and research work, medicolegal and compensation matters, official investigations, case reports, and preventive measures developed and applied are all abstracted as a part of the compilation. The authors intended to continue their work of organization and condensation as information on dust develops by a yearly publication similar to that of 1934.

References listed in the subject index under foundry dust are as follows:

Dust in the Foundry—Dr. E. G. Meiter.

Dust Removal in Foundries—Hunt-Spiller Mfg. Corp., Boston.

Methods of Determining Dust Concentrations—J. W. Fehnel, Industrial Hygiene Laboratory, Metropolitan Life Insurance Co.

Occupational Disease Hazards. Causes and Method of Control. Functions of Health Dept.—F. J. Jirka.

Cleaner Air for the Foundry—E. O. Jones.

Health Hazards in the Foundry Industry—W. J. McConnell and J. W. Fehnel.

Phenolite Corp., 309 St. Johns street, Chicago, has acquired the rights to use certain processes for impregnating wood and other porous materials from the Pyratone Products Corp., Chicago.

MODERN POURING EQUIPMENT

will get you that badly needed extra production from your present molders!

It will get you additional production by eliminating the strain of carrying the metal and cutting down on the pouring time; and greatly decrease the cost of distributing and pouring the metal. In the photo, for instance, one man pours 1000 pounds of malleable iron without fatigue.

Modern Covered and Insulated Ladles
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can be used in pouring devices or directly on cranes in various capacities. They enable handling much larger quantities of metal without discomfort or fatigue, and holding them for longer periods. Especially well adapted for metal refining in the ladle.

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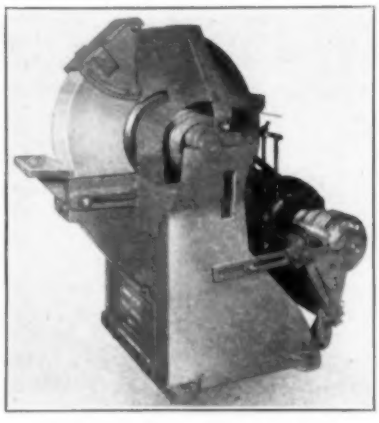

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Write for Catalog or Vibrator Information —Dept. 46

MALLEABLE IRON FITTINGS CO.
Branford, Conn., U. S. A.

Gray Cast Iron (*Chapter V*)

(*Concluded from page 37*)

States patent No. 1,961,777—that sulphur and phosphorus can be used to improve the machinability of austenitic alloys. However, the author has found that high percentages of phosphorus are detrimental to austenitic cast irons.

Due to its low density, manganese sulphide tends to float, and in some cases sulphide segregations prove troublesome. Such seggregations are not infrequent on the cope sides of heavy castings. Hurst has called attention to their occurrence in the bores of centrifugal castings.

The effects of sulphur in gray iron have been studied by a number of investigators. The work of Smith and Riggan—*Proceedings* American Society for Testing Materials, 1928, Part 2, pages 205-216—is referred to here since it is typical and represents recent work done carefully and accurately under actual foundry conditions. Cupola heats were run using a base iron, silicon 1.75 to 2.00 per cent, manganese 0.32 to 0.36 per cent, phosphorus 0.55 to 0.62 per cent, total carbon 3.45 to 3.60 per cent. Sulphur was varied from 0.054 to 0.766 per cent. Care was taken to insure uniform melting conditions and a uniform pouring temperature of 2660 degrees Fahr.

Conduct Numerous Tests

Cylindrical test bars (the old A-48, 1.25 inch diameter arbitration bars) shrinkage bars and fluidity bars were poured. The fluidity bars were wedge shaped 80 inches long cast in open molds.

The following tests were made—

(a) Tensile strength on machined test bar

(b) Transverse test

(c) Combined carbon analysis

(d) Machinability test (drill penetration)

(e) Fluidity test

(f) Contraction test

Results of these tests plotted against sulphur percentage are shown in Fig. 69.

It will be noted that under conditions of the test sulphur has practically no effect on tensile strength, transverse strength or fluidity. Combined carbon and brinell hardness are increased, particularly after sulphur content exceeds 0.18 per cent. Machinability is decreased markedly beyond about 0.20 per cent sulphur. Contraction increases gradually up to about 0.15 per cent sulphur, beyond which point it remains relatively constant. These comments of course apply specifically only to irons of the type examined by Smith and Riggan.

Although high sulphur had little effect on contraction, further experiments by the same investigators showed that purposely oxidized iron produced very great contraction.

In common with other investigators, Smith and Riggan found that in the presence of sufficient manganese, practically all the sulphur is found as manganese sulphide. Due to the slagging of the manganese sulphide they were unable to get simultaneous high manganese and sulphur contents. MacKenzie, in discussing the paper by Smith and Riggan, cited a case where, by suitable manipulation of manganese and carbon, and without basic slags, he reduced an 0.70 per cent sulphur pig iron to 0.06 per cent sulphur. Manganese added was 3.0 per cent and manganese tapped, 1.0 per cent.

Removal of sulphur by flotation of manganese sulphide has been mentioned and an experiment by MacKenzie cited. The various principles of sulphur absorption and control have been known for many years. Since the subject will be covered fully in chapters of the book "Gray Cast Iron" which deal with melting practice, but a few brief references will be made here.

As far back as 1892, Ball and Wingham—*Journal* Iron and Steel Institute—1892, pages 102-105—described the removal of sulphur by the addition of ferromanganese, the sulphide slag being skimmed off. They also described effects of addition of strong alkali plus some cyanide or ferrocyanide in sulphur removal.

Reduction of sulphur content by high lime slags has been recognized for a long time. The author—THE FOUNDRY, Sept. 21, 1921—showed that the sulphur absorption power of cupola slag can be doubled by decreasing the silicon content from 50 per cent to 35 per cent and pointed out the importance of high operating temperatures. Walter made popular the use of highly fusible basic fluxes in the ladle or forehearth, and the use of fused soda ash is quite common in this country, as is discussed in sections of this work, on slags and on fluxes.

Sulphur may be controlled by one or more of the following methods:

(1) Selection of low sulphur melting stock, including use of coke which does not give up large amounts of sulphur to the iron.

(2) Maintenance of basic high lime cupola slags and melting hot. Soda ash increases the absorption power of such slags.

(3) Charging high manganese if sulphur content of stock is high.

(4) Use of fused soda ash or similar alkaline substances in the ladle or forehearth—frequently the most convenient method of sulphur reduction.

(5) Use of material like granular ferromanganese in the ladle.

In all cases but the first, low sulphur content is obtained due to the formation and removal of sulphide rich slag.

Book Review

Wood, Lumber and Timber, by Phillips A. Hayward, illustrated with plates, photographs and tables, 521 pages, published by Chandler Cyclopedia, New York, and supplied by THE FOUNDRY, Cleveland, for $3, plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., London.

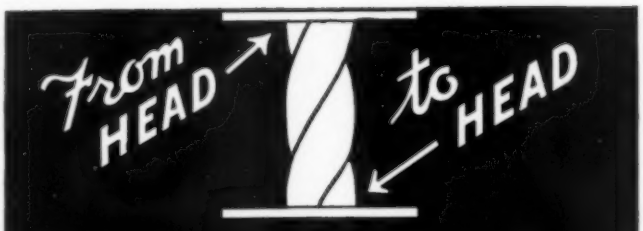
Mr. Hayward has compiled a valuable data book for consumers and fabricators who use wood in any form. The purchasing of lumber intelligently is facilitated by this comprehensive survey of properties and uses of woods. The compilation of the material has been from various sources, such as governmental departments interested in the standardization and utilization of wood, associations, companies, and individuals. All have supplied the most authoritative counsel on this important raw material.

For example, lists of the kinds of woods that pattern and flask makers can use are indexed. This section gives specification and qualities easily chosen for the purchasing and use of lumber.

The volume is divided into various sections, the first section being a discussion on wood structure both physical and mechanical properties. At the end of this section various problems of shipping, deterioration, preservation, etc., are treated. The manufacture and utilization of woods are comprehensively treated next. The identification of woods is simplified and explained. Industrial uses of woods are listed. The introduction to species with their commercial importance, and a separate discussion of hard and soft woods complete the encyclopedia followed by the appendix with tables, bibliographies, abbreviations, and glossary. The book crystallizes the notable facts on wood.

Cleveland Firm Names Representatives

Cleveland Quarries Co., Cleveland has appointed the Buckeye Silica Firestone Western Foundry Sand Co., 1043 Elliott avenue West, Seattle, as representative for the states of Oregon, Washington and for the Canadian province of British Columbia. The Cleveland firm also has designated the M. W. Warren Coke Co., 115 Miller street, St. Louis as representative for the states of Missouri, Kansas, Oklahoma and southern Illinois.



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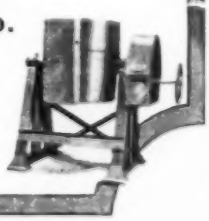
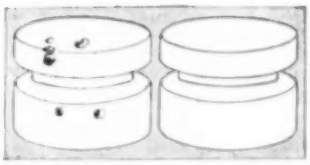


EVERY CASTING SAVED IS MONEY EARNED



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FILLINGS of Smooth-On No. 4 in sand holes, blow holes and other depressions which harm nothing but appearance make good castings better. The surface correction reclaims an astonishing tonnage, and the better value is equally welcome to the customer.

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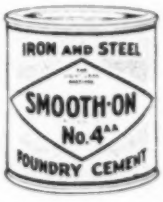

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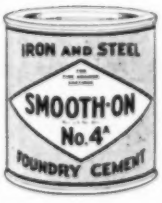

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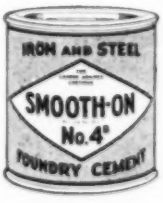

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Molding Sand for Nickel Bronzes

(*Concluded from page* 39)

in which the mold is poured immediately after ramming call for different sands than do other processes wherein the molds stand at times for hours before pouring. Instances are on record where core blows have been caused by the use of a molding sand, which, while having a grain structure correct for the external casting surfaces, was too close to permit the escape of core gases through small prints when relatively heavy sectional metal was poured.

Taking the aforementioned properties as tabulated previously and in the order named, namely moisture, permeability, strength, fineness and refractoriness, we can safely say that moisture (water) can be kept below 6 per cent. A good rule to keep in mind would be that the higher the pouring temperature of the alloy, the less water, providing the other characteristics of sand are of the proper proportion.

For those foundries not having any moisture or sand control apparatus, a simple method for determining water content can be procured by the following procedure: Dry 100 grams of tempered sand for one hour between 221 and 230 degrees Fahr. Cool in covered dish. Reweigh. The loss of weight in grams is the moisture content expressed in percentage.

Sand Loses Life

Water is contained in molding sands in two distinct ways: namely, chemically combined and mechanically held. The chemically combined water is in solution with the many elements of the sand. When sand loses its chemically combined water then it has lost its life. The rate at which the sand loses its chemically combined water determines its life, called durability.

Mechanically held water gives molding sand its temper. Up to temper water acts as a bond, beyond that point it acts as a lubricant. An excess of mechanically held water results in wet sand. The mechanically held water in molding sand is a necessary evil. For that reason, close moisture control should be had of all molding sands.

Moisture can be on the high side without causing any casting defects, provided that the green strength of the sand is not high also. Combination of a high green strength and high moisture is dangerous.

Permeability is that physical property of sand which permits the passage of gases. It is upon that property that the venting qualities of sands and cores depend. The faster gases pass through the molding sand, the higher the permeability, and naturally the slower they pass through, the lower the permeable character. Experience has shown that molding sand suitable for bronze castings whose pouring temperature ranges are between 1850 and 2100 degrees Fahr., should have a permeability of between 20 and 30.

Size of the casting plays an important part with that quality. On the lighter castings, the low limit is ideal, whereas on the castings of heavy sections, a higher permeability is desirable, or around the high limit of 30.

Strength or bond of a molding sand is governed by the amount of clay in its makeup. It will tend to reduce permeability and in excessive amounts will increase fusion on castings, scabs and blows. It is desirable to keep clay content in sand suitable for nickel alloys around 15 per cent. Increase in strength can be procured by adding strong bonded new sand or by a better process of mixing, such as mulling, etc. It also can be increased by reducing the amount of burned or core sand entering the heap.

If the strength is too high, it can be reduced by adding sharp silica sand and less new sand. This process not only reduces strength, but will have a tendency to increase permeability along with the desirable feature of heat-resistant qualities.

It safely can be said that each casting demands a particular sand for best results. Characteristics of the sand would still be governed by the molding methods and detailed operations in the foundry. With exactly the same pattern equipment, the foundry using one type of molding machine would require a radically different sand from that of another foundry using other machines; while the hand or pneumatic shop would get best results on still another sand.

Fineness of a sand refers to the size of the grains. The object of the fineness test is to determine the percentage of the different sizes of sand grains and amounts of clay which the sand contains. The fineness of foundry sand affects the permeability, strength, amount of moisture necessary for mixing, surface of the casting and insulating properties. The finer the sand the more easily it fuses with metals. Fines in molding sand are detrimental as they have no refractory qualities and gradually accumulate from burned sand and vegetable matter called silt. Fines reduce permeability and cause rejects due to washes. As the material has no refractory qualities, it must be considered a poison. It also will have a tendency to form into *pills* which readily can be seen when molders use riddles to lay a fine facing on patterns. These pills should be broken up or discarded entirely. The term refractoriness is applied to sand that has certain heat resisting qualities. Sands having a high silica content are known to have a high refractory quality and are suitable for metals when pouring temperatures are up in the range of 2750 degrees Fahr.

Natural molding sands, high in *silt* also will cause serious trouble. Some sand producers today are furnishing foundrymen with the fusion point of their purchased sand in the specifications. This is another great forward step that is being taken to assist foundries in every way possible to keep rejects at a minimum. Fusion temperature is arrived at by the use of a sintering tester.

Remove The Silt

A sand with a high sintering point will produce castings which are easily cleaned and have superior finish. So-called fines, or silt, in a molding sand are not easily removed although some shops have set up a suction system for that purpose. As this sand is in the process of being aerated, the suction will have a tendency to draw off the fine particles and leave a more open and refractory material.

Molding sands, whether they are natural or made up snythetically, are composed of three elements: Sand grains, clay and water. These three must be controlled. It is up to each foundryman in his particular class of work to determine sand characteristics as best suited for his product. It is hard to suggest what figures or standards will produce quality castings. However, Table V gives some figures which are of the A. F. A. standard numbers governing molding sand characteristics that have been determined as ideal and practical for castings produced in the foundry of the International Nickel Co., Bayonne, N. J. These figures are an average of those taken over a long period of time.

Surveys Sales Activities in Foundries

A booklet, "Merchandising and Selling Gray Iron Castings" recently has been prepared by the Policyholders' Service bureau, Metropolitan Life Insurance Co., New York. The publication represents a survey of more than 50 foundries in the gray iron industry most of which are jobbing shops.

The text includes a discussion of sales strategy employed by foundries, information on analyzing sales possibilities, developing new business, advertising methods, servicing customers, the patternshop as an asset in securing business, the machine shop as an asset in securing business, and sales methods and organization.

ADVERTISING PAGES REMOVED

European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Aluminum Alloys

Progress in Aluminum Casting (Les Progres de la Fonderie d'Aluminium), by A. Dumas. Bulletin de l'Association Technique de Fonderie, Paris, March, 1935.

Dr. Pacz, in 1920, made it possible to make a considerable step forward in casting the aluminum-silicon alloy by the addition of sodium, thus enabling castings to be made with a tensile strength of 27,000 pounds per square inch and an elongation of 7 per cent. However, such castings often presented pin points on their surface. This now is avoided by introducing the sodium through a layer of salts spread over the surface of the metal.

Generally, the greatest difficulty encountered in aluminum founding is the capacity of aluminum and its alloys to absorb certain gases. Investigations on the treatment of the alloy with nitrogen or chlorine, or with titanium or potassium, fluoride, have been made in England with some success.

The elastic limit of Alpax has been increased, up to a point, by the addition of about 0.8 per cent of copper, or of manganese, but suitable heat-treatment gives still better results, especially with an addition of about 0.3 per cent of magnesium and of manganese respectively. An aluminum-copper alloy giving satisfactory results after heat-treatment is composed of copper, 4.75 per cent; titanium, 0.30 per cent. Copper should not exceed 5 per cent, and impurities such as iron and silicon should not exceed 1 per cent in all. The heat-treatment of such alloys should be controlled carefully.

For resistance to corrosion, the best alloys contain one of the following: Silicon, magnesium, manganese and chromium. In Germany, one alloy contains 2 per cent magnesium, 1 per cent manganese and 0.2 per cent antimony, but the casting properties are unfavorable. Alloys containing from 7 to 12 per cent magnesium are not easily attacked and have good mechanical properties. From 7 per cent magnesium upward those alloys can be heat-treated.

These alloys are difficult to cast, owing to their tendency to attack by oxygen when in the liquid state. To obviate that drawback one can use appropriate fluxes that protect the surface of the metal or special sands can be used for molds to avoid humidity.

Sea Coal

Coal Dust in Molding Sand (Der Kohlenstaub in Formsand), by A. Rodehueser, *Die Giesserei*, Dusseldorf, May 24, 1935.

The author states that while it seems to be the general opinion of foundrymen that the value of coal dust in insuring smooth skinned castings, lies in the formation of a protective gas sheath between the molten metal and the mold face, he believes otherwise. He believes that the efficacy of coal dust is due to the formation of a reducing atmosphere in the mold cavity which prevents the formation of an iron oxide skin on the metal that in turn unites with the silica of the sand to form a rough, slaggy condition on the casting surface. The article gives the author's reasoning in arriving at his conclusions, and that is further confirmed by experimental test molds which were made wherein two bars gated from a single sprue were formed in two kinds of sand. One was mixed with coal dust, and the other with potassium nitrate, an oxidizing agent. Potassium permanganate and potassium chlorate also were tried.

Effect of Elements

Influence of the Accompanying and Addition-elements Silicon, Phosphorus, Nickel, Chromium, Molybdenum, Tungsten and Copper on the Wall Thickness Sensitivity of Cast Iron (Einfluss der Begleit—und Zusatzelemente Silizium, Phosphor, Nickel, Chrom, Molybdaen, Wolfram und Kupfer auf die Wandstaerkenempfindlichkeit von Grauguss), by E. Hugo, E. Piwowarsky and H. Nipper, *Die Giesserei*, Duesseldorf, Germany, Sept. 6 and 13, 1935.

The authors conducted an extensive investigation of the effects of silicon and phosphorus in amounts usually present, and as added elements, and also nickel, chromium, molybdenum, tungsten and copper upon the section thickness sensitivity of cast iron. Effect on tensile, bending and shear strengths as well as on hardness and carbide formation were considered. Results confirmed the unfavorable influence of silicon and phosphorus, and the favorable influence of nickel particularly when the latter replaces some of the silicon. The influence of nickel in the presence of chromium is especially favorable, and in the absence of nickel, the silicon content cannot be increased sufficiently to counteract the hardening effect of chromium. Molybdenum functions similarly to nickel, but its effect in hardness adjustment is not so marked. Tungsten and copper have a favorable but less marked to neutral effect in relation to wall thickness influence.

Moisture in Sand

Determination of Moisture in Molding Sands, by S. E. Dawson and F. T. Hanks, *Foundry Trade Journal*, Aug. 15, 1935.

A method has been developed for determining moisture in molding sands, which consists essentially of a special form of electrode used in conjunction with an ohm-meter and suitable batteries, the electrodes being so designed as to get most contact with the mass to be tested. Electrodes are provided with four stems and spikes, the stems being of convenient length to cause the conically formed spikes or contacts to penetrate the mass under test to any desired depth. The electrodes are cross-connected, thus causing the whole circuit to be balanced. This arrangement is said to overcome to a large extent the effect of electrical change which takes place when current passes in one direction only, so causing unsteady readings.

By disposing the four electrode stems as at the corners of a square, the mass of sand subjected to the current paths is roughly of a spherical form, elongated vertically at the center of the zone equal to the length of the electrode points. An arrangement has been embodied whereby known pressure can be applied by hand and operates through a spring on the top side of the electrodes.

Obituary

EARL P. SEDGWICK, 68, president and one of the founders of the Chicago Hardware Foundry Co., Chicago, died at his home in Waukegan, Ill., Sept. 13. Mr. Sedgwick was born in Wheaton, Ill., April 8, 1867, and at the age of 17 entered the employ of the Chicago Hardware Mfg. Co. In 1897 he helped organize the Chicago Hardware Foundry Co. as a subsidiary of the former company and became its secretary and treasurer. He was elected president of the company in 1921. June 1 marked his fiftieth year of service with the company.

♦ ♦ ♦

Maurice I. Johnson, treasurer, Gisholt Machine Co., Madison, Wis., died in that city recently. Mr. Johnson was actively interested in the foundry department of Gisholt for 30 years.

♦ ♦ ♦

Windsor Morris, 64, president, Morris Machine Works, Baldwinsville, N. Y., died at his summer home on Fourth Lake, Fulton Chain, N. Y. Mr. Morris was born in Baldwinsville, attended public schools of that village and was graduated from Cornell university. He became associated with his father in the pump business immediately after his graduation and became president of the company 15 years ago.

♦ ♦ ♦

Arthur Whitcraft, vice president and general manager, Utilities Foundry Corp., Emporium, Pa., died Aug. 26. Mr. Whitcraft had been connected with the foundry and steel industry since 1913. For a number of years he was connected with the American Manganese Steel Co., Chicago, and later with the Hadfield Penfield Steel Co., Bucyrus, O. In recent years he had been engaged in foundry operations with firms making water and gas specialties.

♦ ♦ ♦

Joseph S. Ruble, 57, vice president and general manager of construction, Austin Co., Cleveland, during the World War, died Sept. 4 at Preston Springs, Ontario, after a prolonged illness. He resigned as vice president of the Austin Co. in 1922 to join the H. K. Ferguson Co. in a similar capacity. At the time of his death, Mr. Ruble was supervising project manager for the Federal Emergency Housing Corp. at Cleveland. He was a member of the American Society of Mechanical Engineers.

♦ ♦ ♦

Merton B. Lamkins, 49, general manager, Dodge Bros. Corp. foundry, Detroit, died Sept. 30 after a short illness. Mr. Lamkins was born in Saranac, N. Y. He moved to Detroit 25 years ago and began his automotive career as a pattern maker for the Lozier Motor Co. and later became foreman of the Maxwell Motors Co. When that organization became the Chrysler Motors, he remained in the same capacity. Later he joined the Dodge Bros. Corp. and at the time of his death was general manager of the foundry of that organization.

Three Methods Are Available for Doubling Output on Same Floor Space

THE problem of increasing production is subject to many solutions, including that of providing additional floor space. Occasionally the problem is solved by running a day and night shift. However, since the problem rarely is exactly alike in any two instances, the foundryman has to work out and adopt a compromise. Consider, for example, a foundry engaged in the production of plow points where the molds are stacked six high and where all the available floor space is covered with molds every day. The molds are made on molding machines which straddle the sand heaps and thus travel across the shop from the wall to the gangway on the opposite side. A backlog of orders involving doubling the usual daily output presents a peculiar problem in that hot sand cannot be used since the heat will cause a deposit of moisture on the chills.

Under ordinary conditions hot sand offers no particularly objectionable features so far as its suitability for molding purposes is concerned, but in this particular instance the heat will cause the moisture to condense on the chills with resulting blowholes in the castings. In the long established routine, and this of course applies to the majority of foundries, the castings are shaken out late in the afternoon, the sand is wet down and cut over at night and thus is cooled and in perfect condition for the molders on the following morning.

To meet the problem outlined in the opening paragraph several alternative methods for securing a constant supply of cold sand are presented as a basis for drawing conclusions. 1—Reline the cupola to reduce the melting speed and then pour metal continuously instead of during an hour or two at the close of the day. Shake out the castings immediately after they are poured and wet down the sand. At noon and at midnight cut over all the available sand, approximately 65 per cent. This amount will stand for 5 to 8 hours and will be ready for the next shift to start on. The remainder can be cut after the remaining molds on the floor are shaken out and will be cooled before the succeeding shift arrives at that part of the heap. The main objection of course is that this plan will involve a rearrangement of existing labor gangs.

2—Extend the foundry building to twice the present length or width and provide separate floors for the day and night gangs, either side by side or end to end so that a single monorail would serve for pouring two floors.

3—Install an extensive sand handling plant at one end of the shop; roller conveyors between adjacent floors, extending from the walls to the center of the building and work the double shift by day instead of one shift by day and one shift by night. Thus if 40 men need the entire floor space at present to accommodate the day's work, working in the usual manner from one side of the shop to the other side, 80 men could be provided for on the same floor space by working 40 men from each side toward the center. This plan of course involves continuous pouring and shaking out to prevent crowding of molds on the conveyors.

With conveyors to carry away the molds, the necessity no longer exists for the molding machines to straddle or follow the sand heaps. The day's supply of sand can be piled close to the wall and the machines parked in the immediate vicinity. As fast as the molds are poured they are dumped from the ends of the conveyors onto a grating in the central gangway. Castings and flasks are retrieved. Castings are taken to the cleaning room and the flasks are returned to the vicinity of the molding machines. The sand is carried on a moving belt to the sand conditioning plant at one end of the foundry. Here the stream of sand may be divided to fill storage tanks on each side of the shop, one for each line of molding machines. Some time between midnight and morning the cooled and rejuvenated sand is released from the storage tanks and discharged over a moving belt provided with plows which deposit a designated amount close to the wall at the end of each floor.

This arrangement involves shoveling the sand into the flasks as at present. Under a more elaborate arrangement hoppers above each floor end, receive the sand. Each hopper is provided with a measuring chamber and gate at the lower end. To fill the flask with sand, the molder pulls a rod which opens the gate and the required amount of sand falls into the flask.

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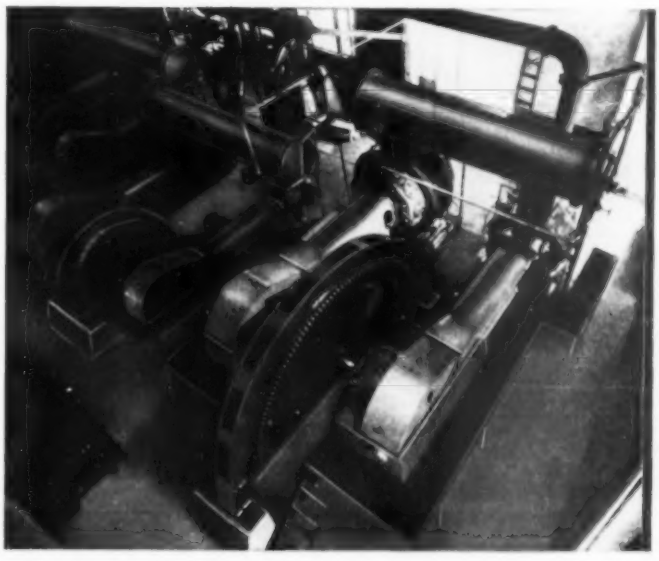

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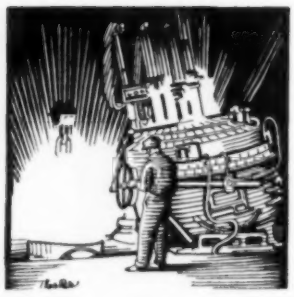
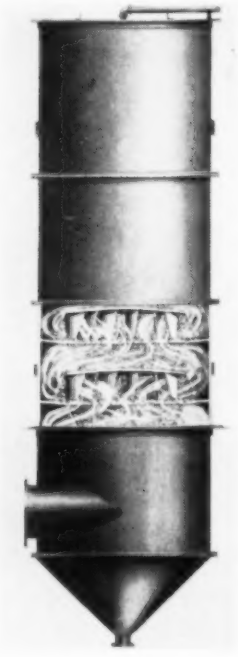


For Foundries

Impingement Spray Removes Dust from Air

Claude Schneible, 4755 North Crawford avenue, Chicago, recently has introduced a line of multi-wash dust collectors for suppressing dust.



Lighter particles are caught by the impingement spray

The design of the collector consists of a series of impingement plates arranged one above the other in a cylindrical tower. Contaminated air is introduced into the tower below the bottom plate. Heavy particles fall into the settling cone, while lighter particles are caught by the impingement spray as they rise in the tower. Features claimed for the collectors include absence of moving parts, pockets or dead zones.

That organization also has developed a multi-louver dewatering tank which precipitates the sludge to the bottom and allows the water or other cleansing liquid to go over the top where it is recirculated or wasted. The unit is designed to reduce silica sludge to 12 per cent or less moisture content, depending upon the period of precipitation. The watering tanks are arranged for dumping into trucks, wagons or railroad cars and are used in series, the number being dictated by the quantity of sludge to be handled.

Sludge pumps developed by that company feature high efficiency, abrasion resisting lead lining and adjustability to meet variation in pressure and volume requirements. They are used for sludge pumping and recirculation wherever abrasive materials are pumped.

Goggle Features Appearance and Comfort

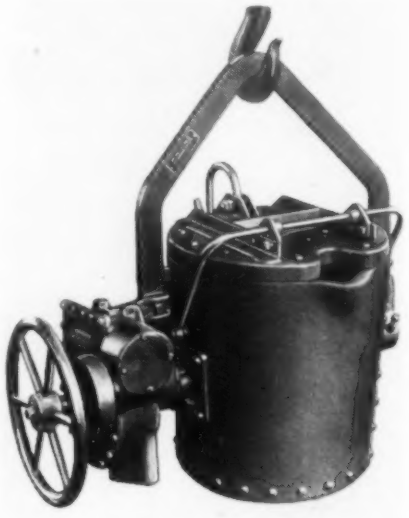
American Optical Co., Southbridge, Mass., has developed a new goggle which features appearance and comfort. For the customary nosepiece, the new goggle substitutes pearl full-rocking nosepads which distribute the slight weight of the goggle on the side rather than on the top of the nose. Ear-pieces are of flexible cable, completely insulated, so that no metal touches the skin at any point. Earpieces are set high on the rim, removing obstructions to full side vision.

Comfortable fitting is made easy by adjustable nosepad support and by the universal swivel that allows the nosepads to conform automatically to the contour of the nose. The lenses are claimed to be capable of withstanding blows approximately twice as heavy as those which fracture standard lenses. A view of the new goggles is shown in the accompanying illustration.

Ear pieces are set high on the rim to aid vision

Introduces Covered And Insulated Ladles

Whiting Corp., Harvey, Ill., recently has introduced a new insulated and covered ladle, which is fitted with a ball bearing helical-worm geared tilting mechanism, automatic safety brake and oil pump. It is claimed that larger areas may be served by one ladle since the metal may be held longer and therefore more metal can be tapped out at one time.



The insulated ladle is fitted with a geared tilting mechanism

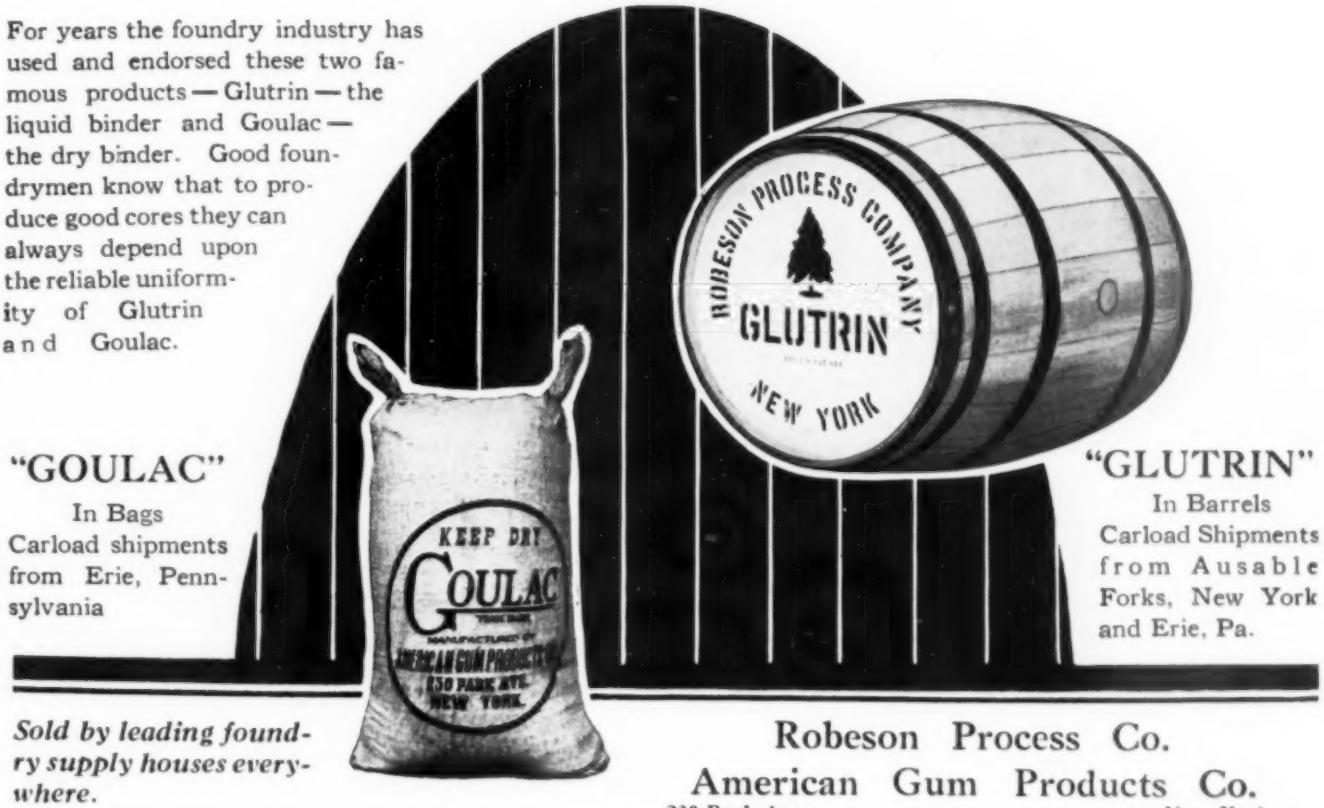
The bottom and sides of the bowl of the ladle are double walled, the two steel shells being separated by a wall of insulating material, tightly rammed in and forming a permanent insulation. The regular mud or brick lining is placed against the inside shell as usual. The cover likewise is lined with a plastic refractory, rammed in. Cover is hinged and arranged with toggle mechanism to permit raising and swinging aside to receive metal.

Holds Outing

Detroit Foundrymen's association held its final golf tournament of the 1935 season Thursday, Sept. 19, at Pine Lake Country club.

DON'T ACCEPT A SUBSTITUTE!

For years the foundry industry has used and endorsed these two famous products — Glutrin — the liquid binder and Goulac — the dry binder. Good foundrymen know that to produce good cores they can always depend upon the reliable uniformity of Glutrin and Goulac.



"GOULAC"
In Bags
Carload shipments from Erie, Pennsylvania

"GLUTRIN"
In Barrels
Carload Shipments from Ausable Forks, New York and Erie, Pa.

Sold by leading foundry supply houses everywhere.

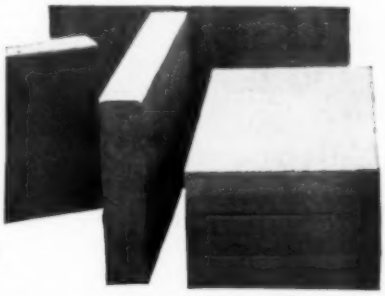
Robeson Process Co.
American Gum Products Co.
230 Park Ave. New York

Rectangular Pieces
Can be split like this, easily and without waste to required thickness.

BUCKEYE SILICA FIRESTONE
(a natural rock)

for lining and patching the melting zone will positively outlast manufactured materials and . . . lower in price.

Can be sawed straight or wedge shapes



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1125 Builders Exchange Building
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Auto Malleables
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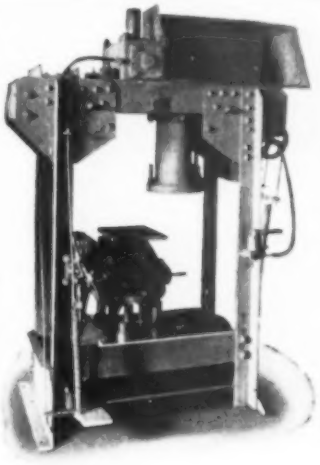


Cores for the above castings are being made universally on our machines, resulting in greatly increased production and better cores.

We have a machine for your job.

Your Correspondence Solicited

Wm. Demmler & Bros.
Kewanee, Illinois

Variable Speed Transmission Motorized

Link-Belt Co., 910 South Michigan avenue, Chicago, recently has incorporated several features of design in its variable speed transmission. The features include motorization when desired, with the motor forming an integral part of the unit; a unit with or without speed reduction gearing; either a horizontal or vertical box; and transmission in five sizes up to 15 horsepower capacity.

Transmission is obtained in five sizes up to 15 horsepower capacity

The transmission formerly was available in sizes up to 10 horsepower with horizontal box only, and without reduction gear sets or integral motor feature. The motorized construction is said to make a compact drive, eliminating the need of a separate motor base plate.

The operating principle of the basic unit remains the same as when produced several years ago. The present changes are in design and construction.

Small Spectograph Handles Simple Spectra

Bausch & Lomb Optical Co., Rochester, N. Y., has introduced a small Littrow quartz spectrograph which has a range of from 2100 A to 7000 A and a linear dispersion between those limits of approximately 150 millimeters. The length of the individual spectrum lines on the photographic plate is 3 millimeters. The entire range is covered in a single spectrogram, hence no adjustments of lens or prism are required.

It is pointed out by the manufacturer that the instrument is not intended to replace medium or large spectrographs for work on complex spectra, where the lines are close together and require high resolving power and dispersion for satisfactory separation. In the case of simple spectra, especially of nonferrous metals, the instrument provides a rapid tool for analysis. It is particularly true if the desired information can be obtained in the shortwave lengths portion of the ultra violet, where the linear dispersion and resolving power of a quartz spectrograph are much greater than at long wavelengths. Under favorable conditions the instrument also can be used for quantitative work.

Motor Drive for Potentiometer Control

Foxboro Co., Foxboro, Mass., has developed a motor drive unit for installations where its potentiometer control pyrometers are used singly. This drive comprises a ball bearing closed motor and a double worm and gear speed reducing system packed in lubricant.

In addition to its availability for single control installations, the drive is sufficiently powerful to operate one additional controller through a coupling between the controllers.

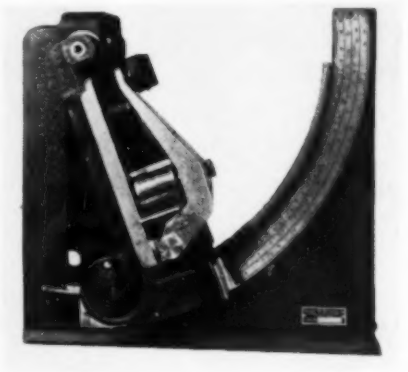
Times Current Flow

A new cycle recorder, a device for giving pictorial evidence of the length of time current flows in an alternating-current circuit, recently has been developed by the General Electric Co., Schenectady, N. Y. The cycle recorder is desired for use with resistance welder timers in calibrating or adjusting the timers or for producing a permanent record of a weld time. By indicating when an accurate resetting of welding time is attained, the new device is useful in duplicating welds previously found to be satisfactory.

Harnischfeger Corp., Milwaukee, is constructing a new building to house its hoist division.

Strength Machine Capacity Is Increased

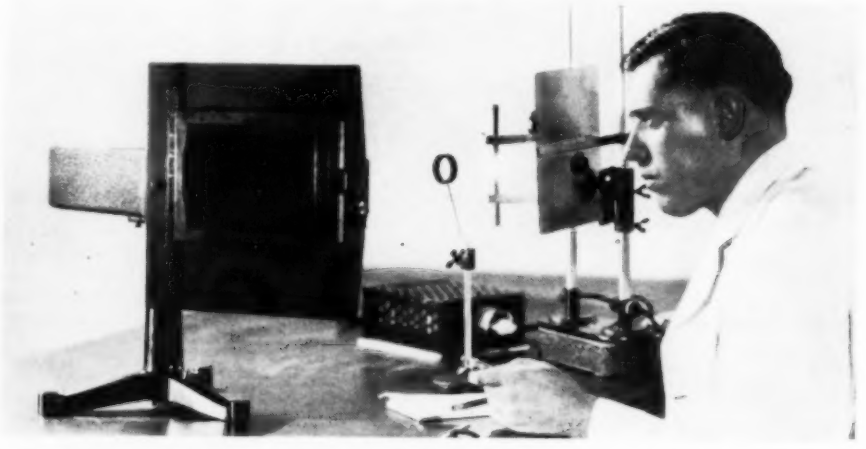
Harry W. Dietert Co., 676 West Grand boulevard, Detroit, has introduced a high dry sand strength accessory quickly attachable to their type C. P. universal sand strength machine. The attachment increases the capacity of the machine to 300 pounds per square inch, dry compression and 220 pounds per square inch, dry shear. It is claimed the additional strength afforded is sufficient to break a sand specimen of mixtures possessing higher dry strength than was possible with the equipment previously available.



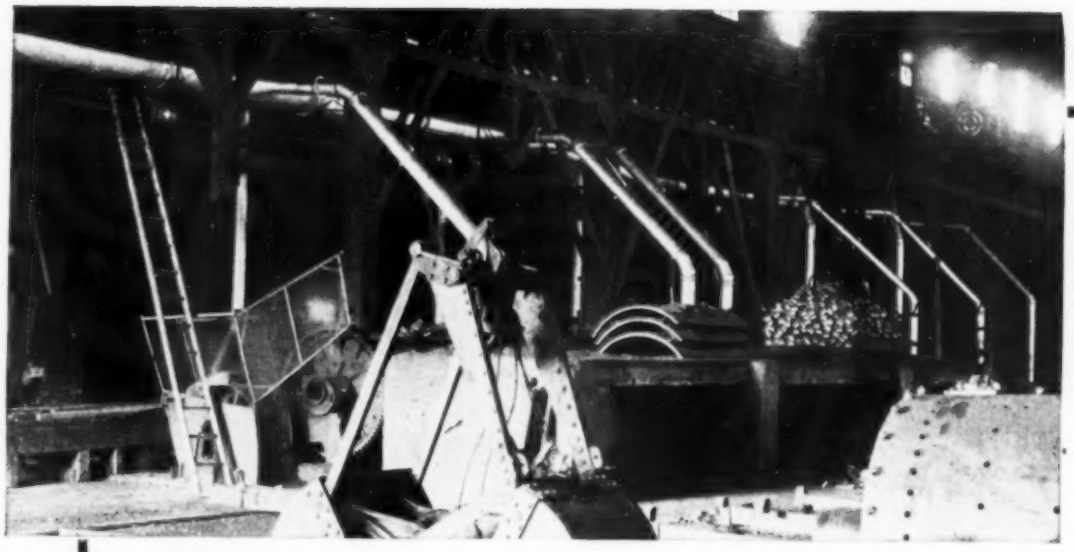
The device is attached to a universal sand strength machine

New Circuit Breaker

A new primary circuit breaker for outlet-box mountings, which provides short circuit and overload protection for 125-volt alternating current or direct current circuits and which also can be used for a switch control on branch circuits, has been developed by the General Electric Co., Bridgeport, Conn. The device is said to eliminate inconvenience in replacing blown fuses and prevents the user from fusing a circuit so that it can be loaded to a capacity.



Length of the individual spectrum lines on the photographic plate is 3 millimeters



K & B installation removing dust from a battery of tumblers. Extra heavy gauge piping is used.

KIRK & BLUM
Dust Collecting Systems

Do a Better Job of Dust Removal

The K & B Dust Removal System does a better job at a substantial saving in power cost. Streamlined fittings and other K & B improvements insure free and rapid air flow. Facts and figures sent upon request. Write

THE KIRK & BLUM MFG. CO. 2808 Spring Grove Ave. Cincinnati, Ohio

Chicago Office: 3843 N. Central Park Ave.
Pittsburgh: The Bushnell Machinery Co., 1501 Grant Bldg.
Louisville: Liberty Blow Pipe Co., Inc., 325 Roland St.

SAND CONTROL Improves Sand Condition

Moisture Teller

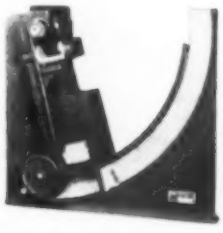
Sand Rammer

Result —

1. Increases production
2. Improves casting finish
3. Improves casting soundness
4. Reduces cost

Sand Control Improves Your Sales By Improving Your Product. Dietert-Detroit Sand Testing Equipment is a paying investment. Dietert-Detroit Laboratory Solicits Sand, Clay and Core Binder Test Work.

Permeability Meter



Universal Sand Strength Machine Type C. P.

Write to

Harry W. Dietert Co.

676 W. Grand Blvd. Detroit, Mich.

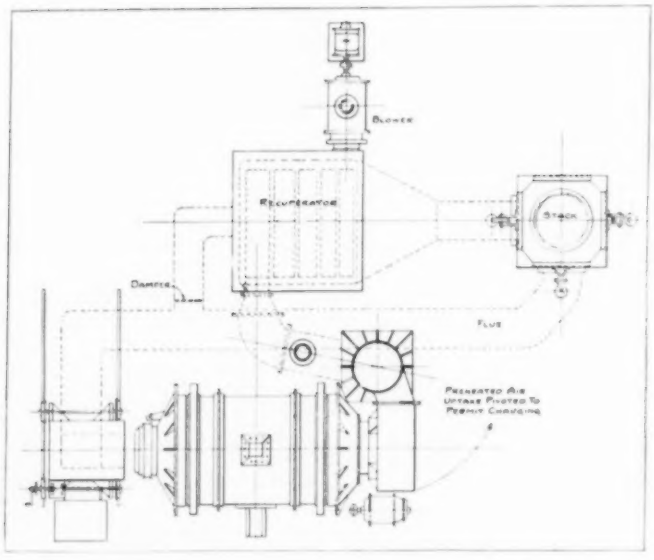
IM GLAD TO SEE THIS IMPROVEMENT IN OUR IRON CASTINGS
YES. IVE BEEN TRYING OUT MALUMINUM IRON COMPOUND AND IT DOES THE WORK.
IS IT EXPENSIVE ?
NO. THE COST ISNT MUCH AS IT TAKES SO LITTLE TO DO THE WORK

FLUXES
FOR
ALUMINUM
BRONZE
BRASS

LADLE FLUXES FOR
CAST IRON

SPECIAL FLUXES FOR SPECIAL ALLOYS

THE MALUMINUM COMPANY TRANSPORTATION BUILDING **INDIANAPOLIS, IND.**



Plan view showing the layout of the furnace and equipment

Rotary Furnace Melts Iron and Steel

Amsler Morton Co. Inc., Fulton building, Pittsburgh, has introduced a rotating type furnace for melting of iron and steel, which originally was developed in France. As shown in the accompanying illustration, the body of the furnace is built of heavy sheet steel with provision made for expansion of the furnace lining. A removable pouring spout is bolted near the center of the furnace body and a cleaning door is provided at the opposite side of the spout for removing slag. A movable manifold permits charging and a movable flue provides access to the furnace at any time.

The entire furnace is supported on bearings on which rollers are mounted. The rollers are power-driven to rotate the furnace at the desired speed. A recuperator is provided for supplying preheated air for combustion. A slag chamber in advance of the recuperator protects against slag or dust and also serves to distribute the waste gas over the entire width of the recuperator.

It is claimed that almost any high B.T.U. fuel may be used in connection with the furnace although fuel oil or powdered coal is preferred. Burners are connected to the fuel supply by flexible hose and to the heated air manifold to permit easy removal while the furnace is being charged.

A rammed refractory lining is provided. The furnace is built for capacities ranging between ½ to 5 tons. In operation, metal is charged with a charging machine at the burner end. The manifold then is replaced and the fire started. The air manifold is so constructed as to make it possible to watch the entire melting operation through a peephole, to take samples of the metal, or to make additions to the batch without stopping the rotation of the furnace. After completing the melting operation, the slag is removed. A brake is provided to maintain the furnace in the proper position while the pouring operation is taking place. It is claimed that first heats require approximately 2 hours and additional melts, 1½ hours.

Polishing Wheel Used for Metal Finishing

A new polishing wheel for all classes of metal finishing work has been developed by the Carborundum Co., Niagara Falls, N. Y. in conjunction with the Columbian Rope Co., Auburn, N. Y. It is claimed that the wheel is produced by combining the strongest vegetable fibre with a scientifically developed and controlled tough, resilient bonding agent.

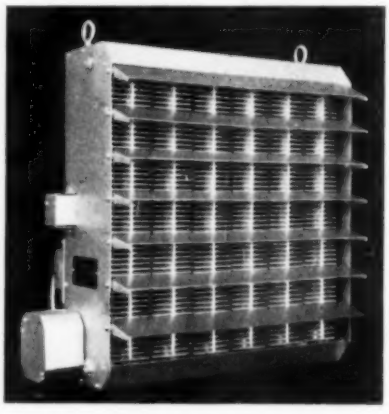
The wheel is made in three densities, namely soft, medium and hard. The wheels are set up with glue and abrasive in the conventional manner. It is pointed out by the manufacturer that water, oil or grease have no deteriorating effect on the materials forming the wheel structure and that the old abrasive head may be removed by cleaning with water. The wheel can be dressed with dry pumice or an abrasive stick.

An accurately machined hub is built into the wheel to eliminate excessive wear or scoring due to frequent wheel changes and to provide true, smooth running.

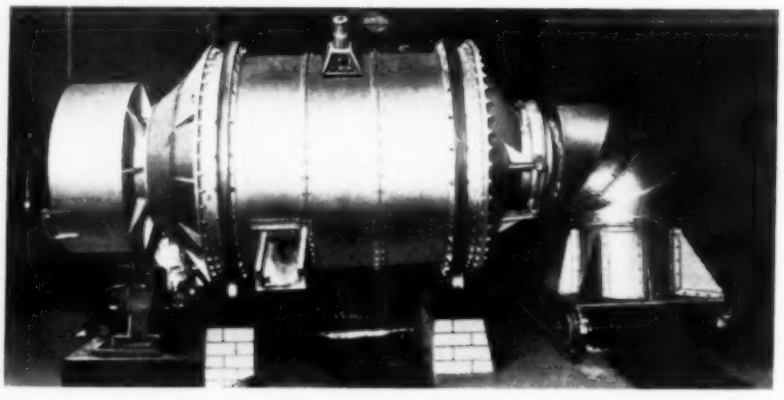
Cast in Heating Unit Features Heater

Electric Air Heater Co., division of American Foundry Equipment Co., Mishawaka, Ind., recently has introduced an electric unit heater which features a cast-in heating unit. It consists of a helicoil sheath wire type of resistance heater element cast integral with an aluminum fin type grid. The heaters are made in various sizes in both the rectangular and round shapes. It is claimed the heat transformed from electrical energy is conducted quickly through the fin area of the heating unit and carried off by forced air circulation. The large convection surface of the unit permits operation at low temperature, the maximum temperature for operation being 250 degrees Fahr.

Three standard types are as follows: Portable unit which can be carried from room to room and plugged into a wall socket; the built-in type; and the industrial type for suspension from ceilings, wall brackets, and for semi-portability.

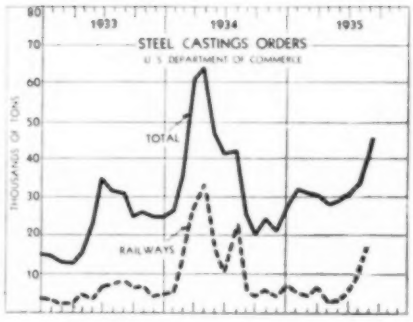


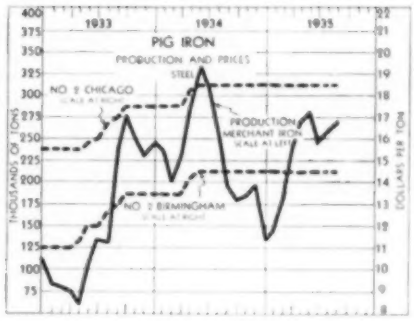
A large convection is provided for the electric unit heater

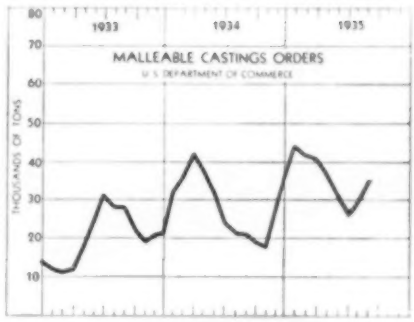


The furnace is supported on bearings on which rollers are mounted

ADVERTISING PAGES REMOVED







Foundry Activities

Reflect Industrial Trends

PONTIAC MOTOR CO., Pontiac, Mich., is preparing to reopen its foundry after a four-year shutdown, at a cost of $500,000 for new machinery and renovation. The plant is expected to be ready for operation in December. Employment of more than 800 men is anticipated.

* * *

Gauthier Foundry Co. Inc., Buffalo, has been incorporated with $10,000 capital to operate a foundry.

* * *

Carthage Foundry & Machine Co., Carthage, Mo., has resumed operation of its foundry.

* * *

Portsmouth Stove & Range Co. foundry department, Portsmouth, O., is being reopened by the Foster Stove Co., Ironton, O.

* * *

Reliable Pattern & Castings Co., Cincinnati, O., is planning to move to its new building at 3530 Spring Grove avenue, shortly.

* * *

Allis-Chalmers Mfg. Co., Milwaukee, plans to spend $175,000 in remodeling and enlarging its plant at La Porte, Ind.

* * *

Flour City Ornamental Iron Works, Minneapolis, is reported considering a northern Iowa site for the establishment of a factory unit.

* * *

Foundry operations in the Chicago district showed gradual improvement during September, with automotive plants among the leaders in effecting higher outputs. Farm implement and sanitary ware manufacturers continue to experience brisk demand.

* * *

Index of foundry equipment orders for August, according to a report of the Foundry Equipment Manufacturers' association, Cleveland, was 113.0 as compared with 93.3 for July and 43.1 for August, 1934. Index of shipments was 97.2 as compared with 102.3 for July and 48.7 for August last year.

* * *

Continental Die Casting Co., 2950 East Woodbridge street, Detroit, is erecting a factory building on Grinnell avenue. Frederick J. Winter is architect.

* * *

Ford Motor Co. of Canada, Ltd., Windsor, Ont., has started on a $500,000 expansion program for its foundry which will double the size and permit the casting of brake drums and other parts of alloy steel or alloy iron in addition to the cast alloy steel crankshafts now being made.

* * *

American Furnace & Foundry Co., and the American Boiler & Foundry Co., Milan, Mich., reopened recently after a short shutdown during which considerable repairs and alterations were made.

* * *

Gra-Iron Foundry Corp., Marshalltown, Iowa, has awarded contracts for remodeling and alterations on its plant, according to Jacob Eige Sr., president.

* * *

American Laundry Machinery Co., Rochester, N. Y., is installing a new casting cleaning department. The contract includes elevating, conveying and screening equipment for the handling of sand.

* * *

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., has leased the machine shop of the former Scott Foundry department of the Reading Iron Co., Reading, Pa., and will occupy it as a branch plant.

* * *

Negotiations looking toward renewed operation of the Decatur Malleable Iron Co., Decatur, Ill., have been entered into by the bondholders of the concern who recently purchased the plant.

* * *

Divekey Foundry & Machine Co., 111 W. Monroe street, Chicago, has been incorporated by J. O. Divekey, Adelor J. Petit Jr., and Florence Stewart to operate a general foundry business.

* * *

Balmar Corp., formerly the Venango Mfg. Co., Franklin, Pa., has moved its plant to Baltimore. Fred G.

RAW MATERIAL PRICES
Oct. 4, 1935

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	14.50
No. 2 foundry, Chicago	18.50
No. 2 foundry, Buffalo	18.50
Basic, Buffalo	17.50
Basic, Valley	18.00
Malleable, Chicago	18.50
Malleable, Buffalo	19.00
Charcoal iron, furnace	21.50
Coke	
Connellsville beehive premium	$5.50 to $ 5.65
Wise county beehive coke	4.30 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$13.00 to $14.00
Heavy melting steel, Pitts.(dlv)	13.50 to 14.00
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Buffalo	10.50 to 11.00
Stove plate, Chicago	8.00 to 8.50
No. 1 cast, New York	7.00 to 7.25
No. 1 cast, mchy., Chicago	11.50 to 12.00
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Philadelphia	12.00
No. 1 cast, Birmingham	9.00 to 9.50
Car wheels, iron, Pittsburgh	14.25 to 14.75
Car wheels, iron, Chicago	12.50 to 13.00
Railroad malleable, Chicago	14.50 to 15.00
Malleable, Buffalo	13.75 to 14.25
Nonferrous Metals	**Cents per pound**
Castings copper, refinery	8.60
Straits tin	50.25
Aluminum, 99 per cent	19.00 to 21.00
Aluminum, No. 12 (Secondary, standard)	16.75 to 17.00
Lead, New York	4.50
Antimony, New York	14.25
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.75

Roemer, foundry superintendent at Franklin and for 20 years connected with the company, now is located at Baltimore.

* * *

Richardson & Boynton Co., Whitesboro, N. Y., with branch plants in Buffalo and Dover, is reported to have been reorganized under federal court supervision.

* * *

Cadillac Malleable Iron Co., Cadillac, Mich., has acquired the Acme plant No. 2 on West Mason and Lake streets and will expand its operations in machining and finishing castings. It will also feature the manufacture of special truck attachments. R. J. Teeter is manager.

* * *

Lorain Castings Co., Lorain, O., recently was severely damaged by fire. The brass shop was almost entirely destroyed and one end of the gray iron shop was damaged extensively. Contract has been let for rebuilding that portion of the gray iron foundry and a part of the plant of the Universal Crane Co., Elyria, has been rented and a brass foundry installed there. The brass shop was scheduled for opening the middle of October.

* * *

Reviving construction and increasing popularity of air conditioning has stimulated business of the L. J. Mueller Furnace Co., Milwaukee, according to a report from H. P. Mueller, president. Sales of the company show an extensive gain over last year and prospects are considered bright for the balance of the year.

* * *

Production of iron and steel castings in the Philadelphia Federal Reserve district increased during August, according to reports of the Industrial Research department, University of Pennsylvania. Tonnage of gray iron castings produced was 13.8 per cent more than in the previous month and approximately 25 per cent more than in the same month last year. As a result of the consecutive increases in the last 4 months, the total output in August was 40 per cent larger than that of last April. Output of malleable iron castings was 10.8 per cent more than in July, 1935 and 25 per cent above the average for 1926.

New Trade Publications

NOZZLES—A pocket data card has been prepared by the Pangborn Corp., Hagerstown, Md., giving the price list of "long-wear" blast nozzles and showing comparative costs of $\frac{3}{8}$-inch blast nozzles. The Pangborn Corp. also has issued two bulletins. One announces a 24-page bulletin on their dust collector, bearing the slogan "Dust Industry's Nuisance Controlled Becomes Dust a Valuable By-product." The other sketches the general make-up of the Rotoblast designed to replace compressed air cleaning.

INSULATION—A folder giving brief discription and uses of high temperature insulation has been published by the Illinois Clay Products Co., Joliet, Ill.

PARTING—Hill & Griffith Co., Cincinnati, discuss the features of Faultless and Partwell parting in a recent folder.

RUST—Rust-Tox method of penetrating the pores of rusted metal, extracting moisture, and rendering rust inactive is explained in a folder of the Skybryte Co., Cleveland.

TOOLS—Jas. Clark Jr. Electric Co., Louisville, Ky., makers of the electric drills, has issued a catalog of its drills, drivers, nut setters, sanders, and bench grinders.

WELDING HOOD—"Slide Front" and "Tilt Front" style welding hoods are described in a bulletin published by the E. D. Bullard Co., 275 Eighth street, San Francisco. The "Tilt Front" style is particularly desirable for work in close quarters.

VALVES—Fairbanks Co., Binghamton, N. Y., has issued a 52-page catalog stating prices according to size. Some of the illustrations are full-page and are labeled to point out special features. One page is devoted to a discussion of the care of valves.

DUST FILTER—W. W. Sly Mfg. Co., 4700 Train avenue, Cleveland, outlines its reasons for the use of the Sly type "EC" dust filter and pictures other kinds of cleaning equipment in a four-page illustrated folder. Dust suppression at its source and dust collection are basic principles of the method.

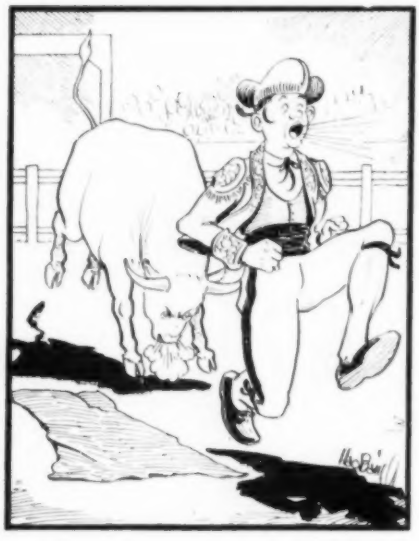
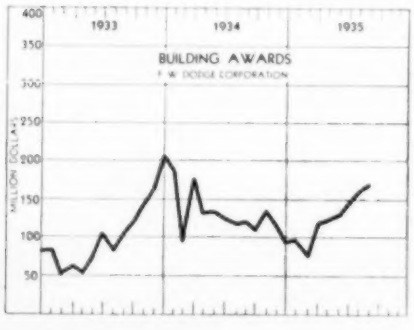
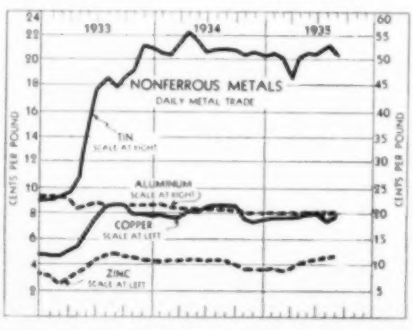
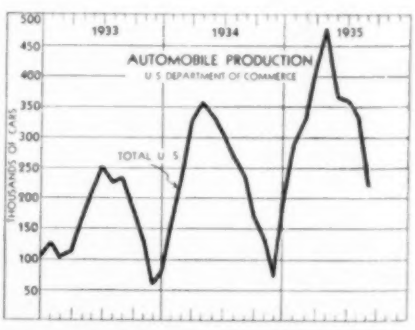
CAST IRONS—International Nickel Co. Inc., 67 Wall street, New York, has published a technical bulletin on the properties of nickel alloy cast irons and their special applications in petroleum production equipment. Photographs, text, graphs and tables combine to make a scholarly presentation.

CONVEYORS—A recent folder of the Link-Belt Co., Philadelphia, describes and illustrates cost-reducing, time-saving portable belt conveyors for industrial plants, retail coal yards, building supply yards, and contractors, for handling loose or bagged bulk materials. Recent improvements are embodied in the machines illustrated.

CORE PLATES—Johns-Manville, 22 East Fortieth street, New York, has published a pamphlet on core plates and pallets for baking cores and drying ceramic ware. They are made from flat sheets of asbestos and portland cement combined under great pressure and treated with a series of impregnations and bakings. The plates are said to be permanently noncorrodible, have negligible warpage, are light in weight, and do not crack easily when dropped.

COLUMBIUM—"Stainless Steel Treated with Columbium" has been issued by Electro Metallurgical Co., East Forty-second street, New York. The pamphlet shows the elimination of intergranular corrosion by the addition of columbium to the austenitic type of stainless steel and in table form gives the physical properties and corrosion-resistance of columbium-treated steels. It is stated the use of columbium-treated welding rods makes possible full corrosion resistance without heat-treatment after welding.

Faked Foundry Facts



Bellows